PETROLEUM REFINER

WARREN'S

STABILIZED NATURAL GASOLINE *and* STA-VOL-ENE

Ready for the Nation's Refiners

WARREN PETROLEUM CORPORATION

Producers, Manufacturers, Exporters and Marketers

Export Terminals: Corpus Christi, Port Arthur, Baytown, Texas City, and Norsworthy, Houston, Texas.

TULSA 2, OKLAHOMA CABLE ADDRESSES: Stavolene, Warren

Crude Oil, Natural Gasoline and Liquefied Petroleum Products

puts the HEAT on heat exchangers

By changing to Yarway Impulse Steam Traps, an oil refinery reports much hotter steam in their heat exchangers **—plus two other important extras:**

(1) They were able to operate the plant with 6 boilers instead of the 8 formerly required.

(2) Three men formerly required to service old-type traps can now be used for productive work.

Significant sidelight—these Yarway traps are operating under severe conditions, many outdoors with temperatures often below zero.

Plant after plant is standardizing on Yarway Impulse Steam Traps because Yarways are designed to deliver the most premium B.T.U.'s at top temperatures into your process or product. **They get equipment hotter, sooner . . . and keep it hot.**

Other reasons—small size, easy installation, good for all pressures, only one moving part, low maintenance, low price.

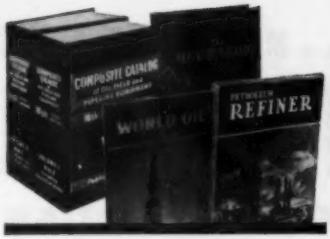
Buy your Yarway Impulse Steam Traps from the nearest of 216 distributors. For name, write us.

ACTUAL SIZE ¾" YARWAY STEAM TRAP

YARNALL-WARING COMPANY
128 Mermaid Ave., Philadelphia 18, Pa.

FREE OFFER. Don't take our word for it. Test Yarway's advantages in your own plant, without cost or obligation. Drop us a card or letter—a trial trap will be delivered promptly.

YARWAY the steam trap
designed with more production in mind



RAY L. DUDLEY, *Publisher*
WILLIAM L. BOLLES, *Editorial Director*
SILAS B. RAGSDALE, *Managing Editor*
GEORGE B. GIBBS, *Associate Editor*
L. J. LOGAN, *Economics Editor*
ALICE L. GIVEN, *Editorial Assistant*
DR. E. H. LESLIE, DR. H. B. COATS
AND DR. HEINZ HEINEMANN
Department Editors
ROBERT E. SPANN, *Eastern Editor*
MARY E. ZUBER, *Librarian*

THE GULF PUBLISHING COMPANY
Box 2608, Houston (1), Texas

Specialized Oil Publications of

PETROLEUM REFINER and The REFINERY CATALOG
for the refining-natural gasoline industry

WORLD OIL (formerly The Oil Weekly)
and The COMPOSITE CATALOG
for the drilling-producing-pipe line industry

TOM W. NELSON, *Advertising Manager*
ROGER MOTHERAL, *Eastern Adv. Mgr.*

Advertising Representatives

NELSON BIGELOW
250 Park Ave.
New York 17, N. Y.

BILL WESTFALL
1010 Euclid Ave.
Cleveland 15, Ohio

H. G. FITZPATRICK
MARTIN HALLORAN
332 S. Michigan Ave.
Chicago 4, Ill.

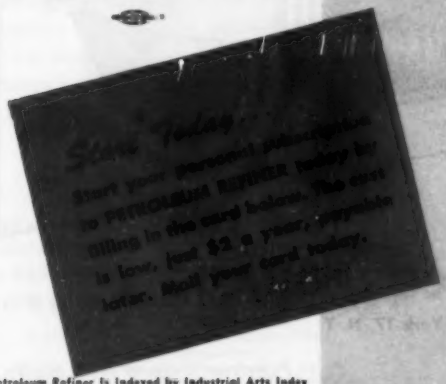
CHARLES WYATT
DOUG CRAIG
3301 Buffalo Drive
Houston 6, Texas

J. W. CURTS
W. W. Wilson Bldg.
Huntington Park, Calif.

BILL ATCHESON
Hunt Bldg.
Tulsa 3, Okla.

Circulation Department
R. M. DE SOMBRE, *Manager*
Box 2608, Houston, Texas

Single copies 50 cents (except special issues) for U. S. and Canada; $1 for all other countries. Subscription rates—U. S. and Canada $3 a year; Latin America $5 a year; overseas $10 a year. PETROLEUM REFINER, published every month, entered as second class matter June 16, 1923, at the post office at Houston, Texas, under act March 3, 1879. Advertising rates on application.
Copyright 1950 by Gulf Publishing Company.


Start Today
Start your personal subscription to PETROLEUM REFINER today by filling in the card below. The cost is low, just $3 a year, payable later. Mail your card today.

Petroleum Refiner is indexed by Industrial Arts Index and by Engineering Index, Inc.

PETROLEUM REFINER

Specialized for Refining, Natural Gasoline and Petrochemical Engineering, Operation and Management

R. L. DUDLEY, President — A. L. BURNS, General Manager
VOLUME 30, NO. 10 — OCTOBER, 1951

Contents

European Refining and Middle East Crudes 73
Middle East oil reserves, explored and developed by Western capital, must be protected as big factor for Western security.
Gustav Egloff

Saturation Seen in Styrene Demand 105
A Staff Petrochemical Market Report.

Corrosion Resistance of Alloys in Amine Gas Treating Systems ... 107
Discussion of corrosion difficulties encountered in gas treating plants using aqueous or glycol-amine solutions. Corrosion data on full-scale equipment is included.
F. C. Riesenfeld and C. L. Blohm

Monsanto Completes Newport Petrochemical Installation 116

Mutual Solubilities of Light Hydrocarbons—Water Systems 118
New experimental data are presented on liquid phase solubilities at pressures from 1000 to 10,000 psia.
W. B. Brooks, G. B. Gibbs and J. J. McKetta

How to Do It 121

Analysis of Some Corrosion Problems in Petroleum Refineries ... 124
Fifteen case records of refinery corrosion problems point the way for others with similar conditions.
John F. Mason

Refinery Control Problems 132
Process control problems are treated with the case history technique to illustrate practical methods of solution.
E. D. Mattix

Drum Reconditioning Gets Into Full Swing 137

Basic Orifice Factors for Heavy Wall Pipe 139
Here are the tabulations of orifice factors for heavy wall pipe which have not been available heretofore.
J. D. Arant

Aramco's Ras Tanura Refinery 141
David Arnett

Supports for Vertical Pressure Vessels, Part III 143
Supporting structures for pressure vessels must be designed so as to accommodate anticipated temperature and pressure changes.
F. E. Wolosewick

New Dunkirk Refinery on Stream 146

Introduction to Chemical Reaction Calculations, Part II. Reaction Kinetics 147
Chemical reactions may be of first, second, or higher order, and knowledge of reaction kinetics is a powerful tool for reactor design.
A. M. Platt and G. L. Farrar

Pressure Drop Through Bubble Caps, Part III, Application of Theoretical Equations 153
Detailed knowledge of vapor flow through bubble caps enables design of high efficiency trays.
J. L. Huitt and R. L. Huntington

Europe's First Modern Cat Cracker Completed 155
E. N. Tiratsoo

The Vapor Pressure of Gasoline 157
A nomograph for the conversion of RVP to true vapor pressure for gasoline.
George E. Maguiome

L'Avera Refinery Capacity Trebled by Redesigning 160

DEPARTMENTS

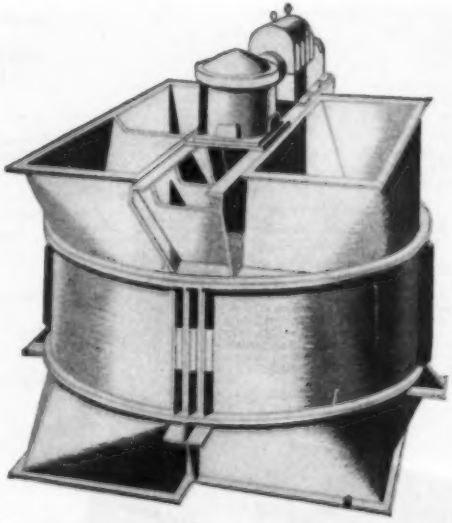
The Look Box 67
Refinery and Other Plant Construction 81
Construction Boxscore 86
How to Do It 121
Refiner Authors and Other Personalities 161
The Month in the Industry 164
Oil Man's Calendar 168
For More Information on Products Advertised 192
Manufacturers' Literature ..... Insert 192-3
New and Improved Equipment 193
New Catalogues and Equipment Literature in Advertisements 203
Science and Technology Abstracts 181
Compiled by Drs. E. H. Leslie and H. B. Coats
Digest of United States Patents Pertaining to Petroleum ... 205
Compiled by Dr. Heinz Heinemann
Book Reviews 225
About Equipment and Service Suppliers 230
Index to Advertisers 238

GET ALL 3 with the LJUNGSTROM AIR PREHEATER

✓ Improved Combustion
✓ Better Heat Recovery
✓ Plant Material Savings

The Ljungstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves the heat is transferred from the waste gases to the incoming cold air.

If you want to improve the combustion of low-grade fuels . . . raise the level of heat recovery . . . conserve critical materials in plant design . . . you or your consultants can make profitable use of Preheater experience. Let our specialists tell you more about the Ljungstrom Air Preheater, and the outstanding job it has done for hundreds of America's leading industries and public utilities, where the need for preheated air from 300F to approximately 1200F was part of their problem. Our engineers are ready to work with you in applying the Ljungstrom to your own heat recovery problem.



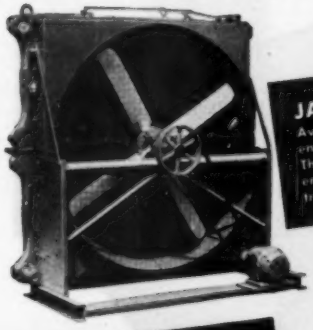
THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N. Y.

YOUNG OFFERS . . .

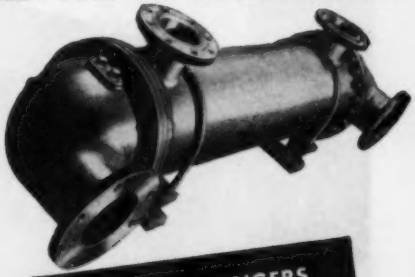
EFFICIENT HEAT TRANSFER

IN WATER, OIL, GAS COOLING-STEAM AND VAPOR CONDENSING



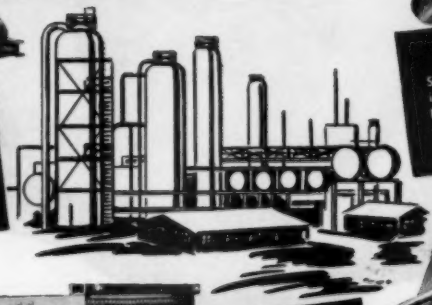
JACKET WATER COOLERS

Available in a wide range of sizes for engine jacket water or lube oil cooling. These units are sturdy, compact, and engineered to provide maximum heat transfer with low hp requirement.



"HC" COOLERS

Multiple unit installations provide economical handling of water, oil or gas cooling and steam and vapor condensing in any combination. Easily installed in the field.



HEAT EXCHANGERS

Space-saving units available from stock in fixed or removable tube bundle types. For jacket water or lube oil cooling in stationary or marine (fresh and salt water) applications.

"VAD" COOLING AND CONDENSING UNITS

Vertical air discharge units for extra large capacity cooling of water, oil and gas and condensing of steam and vapor in any combination. Low-level mounting means ease and economy in maintenance.

In addition to the field-tested products shown above, Young offers: gas, gasoline and Diesel engine cooling radiators; atmospheric and evaporative coolers and condensers; supercharger intercoolers, and similar products for the Petroleum Industry. Young supplements the design engineering of its equipment with application ingenuity thereby increasing the practicability of all Young products. For example, the popular "Vertiflow" Unit Heater, has been used successfully as an economical condenser. It can also cut heating costs by using the waste heat from engine jacket water for space heating. Young *engineered* applications cost no more. Contact your nearest Young Representative for further details.

YOUNG

Heat Transfer Products for Automotive and Industrial Applications.

Young Quality

Heating, Cooling, Air Conditioning Products for Home and Industry.

YOUNG RADIATOR COMPANY

Dept. 751-K • RACINE, WISCONSIN
Factories at Racine, Wisconsin and Mattoon, Illinois

OIL FIELD DISTRIBUTORS:
TULSA: J. R. Mock Company, 1341 S. Boston St., Rm. 109
LOS ANGELES: Flournoy & Everett, Inc., 5043 Santa Fe Ave.
MUSKEGON: Harold J. Young, 206 Montgomery Bldg.
Other Representatives in Principal Cities

COUPON BRINGS DETAILS ON YOUNG PRODUCTS

YOUNG RADIATOR COMPANY
Department 751-K
Racine, Wisconsin

Please send information on the Young Products checked below; also name and address of your nearest representative.

- ☐ Heat Exchangers
- ☐ Jacket Water Cooling Radiators
- ☐ "HC" Cooling and Condensing Units
- ☐ "VAD" Cooling and Condensing Units

NAME _____

COMPANY _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

How to add machining capacity without adding machines

YOUR machine tools become more productive when you use Timken® seamless tubing instead of bar stock for hollow cylindrical parts. Timken tubing has the center hole already there. Drilling is eliminated. Finished boring is often your first production step. As a result, screw machine stations are released for other operations.

You save steel, too, by using seamless tubing. Since the hole is already there, there's less metal that has to be machined away. You get more parts per ton of steel. And to further assure savings in material, the Timken Company provides a tube engineering service which recommends the most economical tube size for your job—*guaranteed* to clean up.

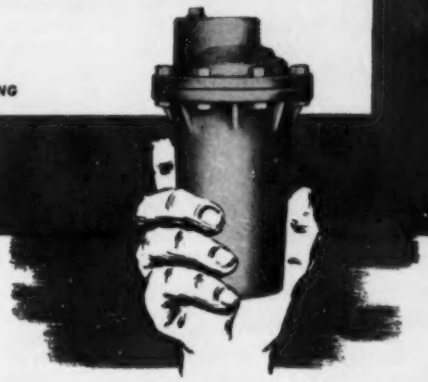
All this and better quality too! Because the piercing process by which Timken seamless tubing is made is basically a forging operation, you have fine forged quality in your product—greater strength and toughness. And from tube to tube and heat to heat, this quality is always uniform. It's rigidly checked at every step in production. The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".

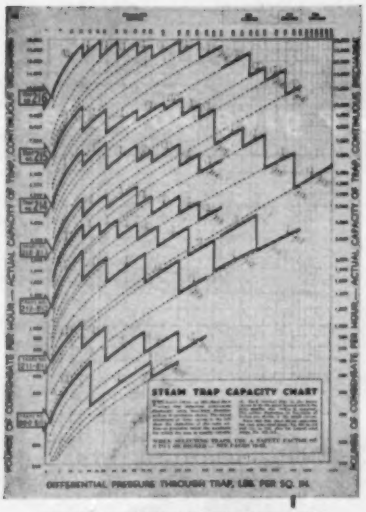
YEARS AHEAD—THROUGH EXPERIENCE AND RESEARCH

Specialists in alloy steel—including hot rolled and cold finished alloy steel bars—a complete range of stainless, graphitic and standard tool analyses—and alloy and stainless seamless steel tubing.

Only actual hot condensate capacities give a true picture of steam trap value

YOU KNOW THE CAPACITY WHEN YOU BUY AN ARMSTRONG





IT PAYS TO KNOW BEFORE YOU BUY!

THE ARMSTRONG STEAM TRAP CAPACITY CHART is based on hundreds of tests with hot condensate. You can depend on its accuracy.

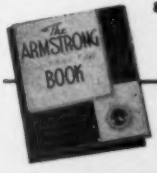
SEE OUR CATALOG IN SWEETS OR CEC

THEORETICAL calculations fail entirely to give a true picture of trap capacity. Orifice tests fail to account for capacity losses caused by pipe friction. Tests with cold or warm water do not take into consideration the capacity-reducing effect of flash steam. Only tests with actual trap hookups handling hot condensate will tell you the true continuous discharge capacity of a steam trap—and those are the capacities Armstrong gives you.

If capacities are misleading you may buy a trap too small for the job. Or, if you compare different makes of traps on a price basis you must know if they are comparable on a capacity basis or the comparison means nothing.

Dollar for dollar and size for size Armstrong steam traps give you greater capacity—another reason why they are your wisest buy. Your nearby Armstrong Representative can supply you. Call him for recommendations.

ARMSTRONG MACHINE WORKS
852 Maple Street • Three Rivers, Michigan



The 36-PAGE STEAM TRAP BOOK gives Armstrong trap capacities and tells how to select the right size trap for every job. Ask for a copy.

ARMSTRONG STEAM TRAPS

Time and money saving ideas of how you too can take advantage of Master's unusual ability to provide the RIGHT horsepower, the RIGHT shaft speed, the RIGHT construction features, the RIGHT mounting . . . all combined into one compact power package.

Don't put up with make-shift assemblies when you too may be enjoying these advantages. Master Motors, available in thousands and thousands of types and ratings (up to 150 HP) give you a selection you can get nowhere else.

Open, enclosed, splash-proof, fan-cooled, explosion-proof . . . horizontal or vertical . . . for all phases, voltages and frequencies . . . in single speed, multi-speed and variable speed types . . . with or without flanges or other special features . . . with 5 types of gear reduction up to 432 to 1 ratio . . . with electric brakes . . . with mechanical variable speed units . . . and for every type of mounting . . . Master has them all and so can be completely impartial in helping you select the one best motor drive for YOU.

this may give you ideas

Select the RIGHT power drive from Master's broad line and you can increase the saleability of your motor driven products . . . improve the economy and productivity of your plant equipment.

THE MASTER ELECTRIC COMPANY
DAYTON 1, OHIO

DUCTILE IRON

A Revolutionary Metallurgical Development

DUCTILE IRON is a cast ferrous product which combines the *process advantages* of cast iron with many of the *product advantages* of cast steel.

No longer in the pilot-plant stage, this new material is now produced and sold on the basis of specifications. Not only are its individual properties exceptional, but no other common engineering material provides such a combination of excellent castability and fluidity, with high strength, toughness, wear resistance, and machinability.

Actually, "ductile iron" denotes not a *single* product, but rather a family of ferrous materials characterized by graphite in the form of spheroids . . . a form controlled, in a broad sense, by small amounts of magnesium. Presence of spheroidal rather than flake graphite gives this new product a ductility that is unique among gray cast irons.

Four important types of ductile iron now being produced commercially are tabulated below.

REPRESENTATIVE MECHANICAL PROPERTIES OF COMMERCIAL HEATS OF DUCTILE IRON

	Grade	Tensile strength, psi	Yield strength, psi	Elongation per cent	BHN	Usual condition
A	90-65-02	95/105000	70/75000	2.5/5.5	225/265	As-cast
B	80-60-05	85/95000	65/70000	5.5/10.0	195/225	As-cast*
C	60-45-15	65/75000	50/60000	17.0/23.0	140/180	Annealed
D	80-60-00	85/95000	65/75000	1.0/3.0	230/290	As-cast

A Pearlitic in structure. Provides good mechanical wear resistance.

B Pearlitic-ferritic in structure. Provides strength and toughness combined.

C A fully ferritic structure usually obtained by short anneal of either (A) or (B). Provides optimum machinability and maximum toughness.

D Higher phosphorous content than preceding grades, also higher manganese. Provides high strength and stiffness, but only moderate impact strength.

SOME UNIQUE PROPERTIES OF DUCTILE IRON

1. Its elastic modulus, about 25,000,000 psi, is virtually unaffected by composition or thickness . . .

2. It can provide a chilled, carbidic, abrasion-resistant surface supported by a tough ductile core. No other single material can combine these properties . . . its only counterpart being a tough material coated with a hard welded overlay.

3. As-cast ductile iron of 93,000 psi tensile strength has the same machinability rating as gray iron with a strength of 45,000 psi.

4. Annealed ductile iron can be machined at a rate 2 to 3 times that of good quality gray iron.

5. It can be satisfactorily welded.

APPLICATIONS

Automotive, agricultural implement, railroad and allied industries apply ductile iron, as-cast and heat treated, in components too numerous to detail.

Machinery, machine tools, crankshafts, pumps, compressors, valves and heavy industrial equipment such as rolls and rolling mill housings, utilize its high strength and rigidity.

In scores of engine, furnace and other parts serving at elevated temperatures, it provides oxidation and growth resistance heretofore unavailable in high carbon castings.

Other applications include paper, textile and electrical machinery, marine equipment, and pipe.

AVAILABILITY

Send us details of your prospective uses, so that we may offer a list of sources from some 100 authorized foundries now producing ductile cast iron under patent licenses. Request a list of available publications on ductile iron . . . mail the coupon now.

EMBLEM OF INCO SERVICE

The International Nickel Company, Inc.
Dept. PR, 67 Wall Street
New York 5, N. Y.

Please send me a list of publications on:

DUCTILE IRON

Name _____ Title _____

Company _____

Address _____

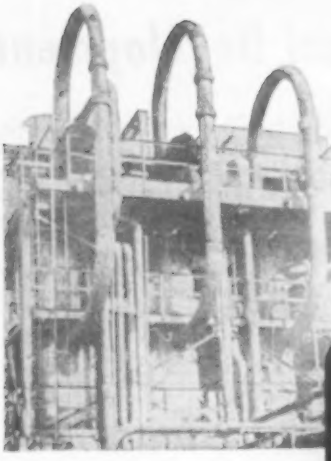
City _____ State _____

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N. Y.

100 temperatures recorded

by One

Speedomax recorder



ESSO

phenol extraction unit
Bayonne, N. J.

It would take six 16-point recorders—each with its own chart—to give the same information which is concentrated on the one chart of the 100-point Speedomax Recorder shown above. Reading one chart instead of six saves time—a busy man can check temperatures more often. The danger of mistakes resulting from a comparison of six separate charts is eliminated.

Minimized Cost Per Thermocouple Point

Instrument cost per point recorded is less than that for any other L&N recorder! Panel space is reduced by two-thirds. Scanning of 100 points during a heat balance check requires only six minutes, forty seconds. If, like Esso, you are interested in only 20 of the 100 temperatures as long as the process is operating smoothly, you can read them in only 80 seconds.

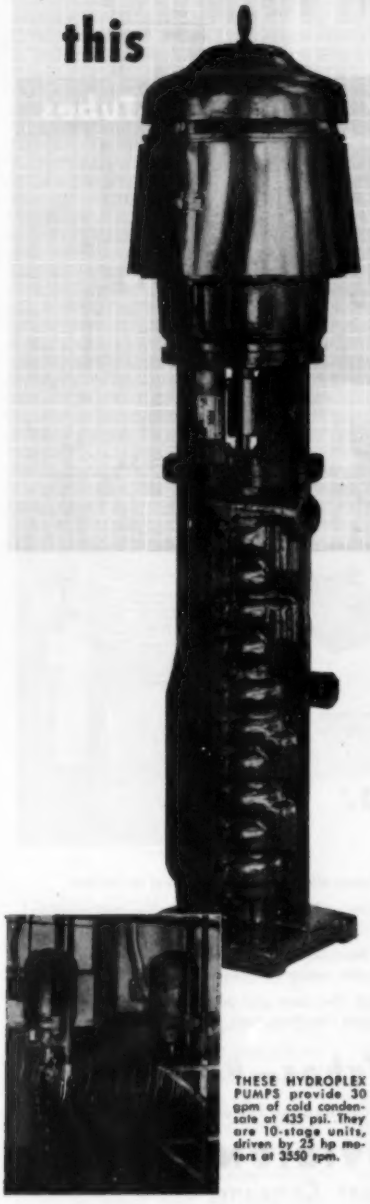
You need not provide for 100 thermocouples unless you need them, since instrument capacities range from 40 to 160 points. Four types of operation are always at hand:

1. **Continuous Indicating but no Recording.** All points are indicated in succession.
2. **Automatic START-STOP.** In this type of operation, a specified temperature limit is set. As long as no thermocouple point exceeds this limit, the Speedomax simply indicates. But if any point should exceed the limit, automatic recording of all points begins and an alarm is sounded to summon the operator. Thermocouple connections are grouped in banks of 20, and a different temperature limit can be set for each bank.
3. **Continuous Recording.** Automatic recording of all points.
4. **Selective Indicating or Recording.** Indicating or recording of any bank, combination of banks, or single point.

To get more facts, write our nearest office, or 4923 Stenton Ave., Phila. 44, Pa. Ask for Folder ND46-33A(1).

LEEDS LN NORTHRUP

this small, low-priced BJ HYDROPLEX PUMP is *engineered* for economical boiler feed service



THESE HYDROPLEX PUMPS provide 30 gpm of cold condensate at 435 psi. They are 10-stage units, driven by 25 hp motors at 3550 rpm.

- For medium pressure, medium temperature, low capacity pumping.
- Uniform, non-pulsating flow.
- Variable capacities without by-pass or speed change.
- Vertical construction—needs only a simple foundation and a minimum of floor space.
- No relief valves.
- Only one stuffingbox . . . and it is under suction pressure.
- Radial forces balanced at all loads by staggered volute construction.
- Axial thrust balanced by opposed grouping of impellers.
- Easily dismantled and reassembled.

IF YOUR PUMPING JOB involves a medium pressure, medium temperature, low capacity operation, the BJ Hydroplex can do it with quiet, smooth efficiency *and with less installation and maintenance cost*. This smaller, low-priced version of the highly successful BJ Hydropress centrifugal pump has a capacity range from 10 to 140 gpm at heads of 450 to 1700 feet. It operates at high speeds—3550 rpm on 60 cycle and 2950 on 50 cycle and higher in special units.

You'll find that this simple, dependable BJ Hydroplex has definite advantages over complex displacement type pumps. For full information, send the coupon now.

Byron Jackson Co.

Since 1872

P. O. Box 2017 Terminal Annex, Los Angeles 54, Calif.

OFFICES IN PRINCIPAL CITIES

BJ PUMP DIVISION, DEPT. 27

Our problem is pumping_____ gpm of_____ at a head of_____ Tell me more about the BJ Hydroplex.

NAME_____

COMPANY_____

ADDRESS_____

CITY_____ STATE_____

No obligation, of course.

Now

A faster and more economical way to install U-Tubes

Here's how the finished package comes to you. Simply remove the protective covering and the tubes are ready for installation. Either Wolverine Trufin® or plain tubes can be shipped to you on this kind of pallet.

At the right is shown one of the shipping pallets fully loaded. It shows the tubes bent to the correct radii, packed for immediate pallet-to-condenser installation.

Look at all these Advantages:

1 Tubes are fed directly, from shipping pallet into heat exchanger or condenser as they are needed! They are all bent to the correct radii and packed in the right sequence—in line or staggered—according to your prints. Removal can be made from the end or top of pallet.

2 All tubes for one condenser are shipped on one pallet.

3 Instant inspection—eliminates sorting, counting, and handling.

4 Pallet can be handled with existing equipment. Present handling equipment is needed only once to bring pallet to the job.

5 Hairpin-bend tubes eliminate one tube sheet or header.

6 Pallet saves time, crane movements, storage and working space.

7 Pallet is easily knocked down and returned. Supporting straps are cushioned with rubbery compound to protect tubes.

8 Pallet eliminates the time and expense of removing and destroying crating resulting from antique packing methods.

Specify Wolverine Condenser Tubes—Palletized!

WOLVERINE TRUFIN AND THE WOLVERINE SPUN END PROCESS AVAILABLE IN CANADA THROUGH THE UNIFIN CO., LONDON, ONT.

WOLVERINE TUBE DIVISION

Calumet & Hecla Consolidated Copper Company

INCORPORATED

Manufacturers of seamless, non-ferrous tubing

1431 CENTRAL AVENUE • DETROIT 9, MICHIGAN

Wolverine Condenser Tubes stocked by Baxter Industries, Inc., 355 South Fourth Street, Beaumont, Texas • Tel.: Beaumont 3-2351

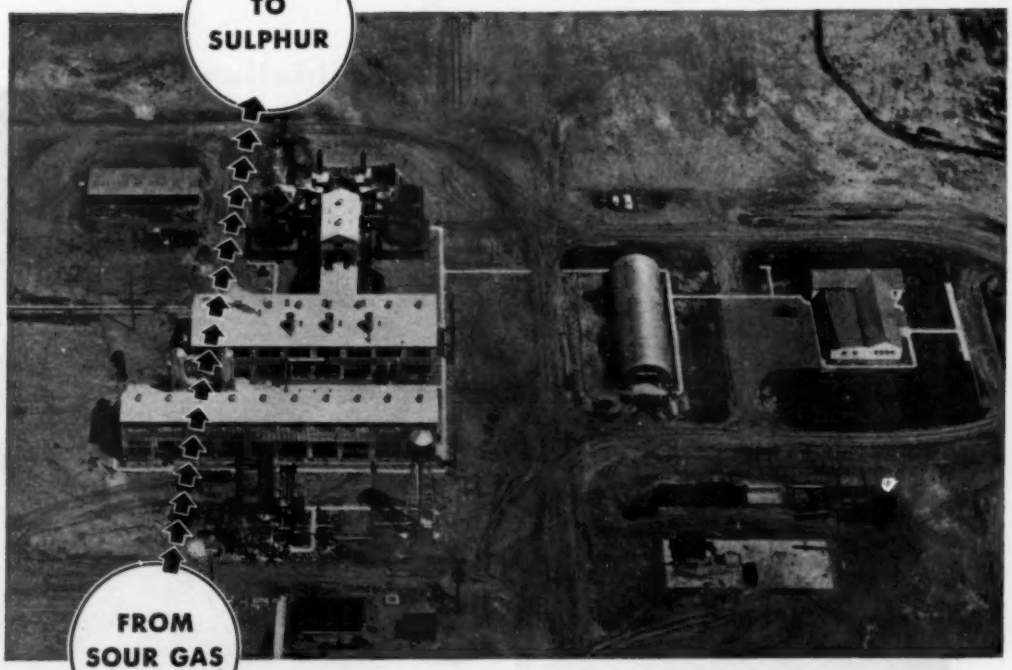
*Reg. U.S. Pat. Off.

PLANTS IN DETROIT, MICHIGAN AND DECATUR, ALABAMA

Sales Offices in Principal Cities

Export Department, 13 E. 40th St., New York 16, N. Y.

Girdler handles construction of largest U. S. plant



BEFORE this new Wyoming plant of the Texas Gulf Sulphur Company went in operation, large volumes of "sour" natural gas released at the wells of the Worland Oil Field had to be burned and wasted as the gas contained about 30% hydrogen sulphide, an evil smelling and poisonous gas.

Then came plans to turn waste products to profits—by separating the hydrogen sulphide, converting it to sulphur and selling the purified gas.

The prime contract for engineering and constructing these facilities, embracing a gas purification plant, sulphur recovery plant, water softening plant, sulphur storage and loading equipment, and buildings, was handled by The Girdler Corp.

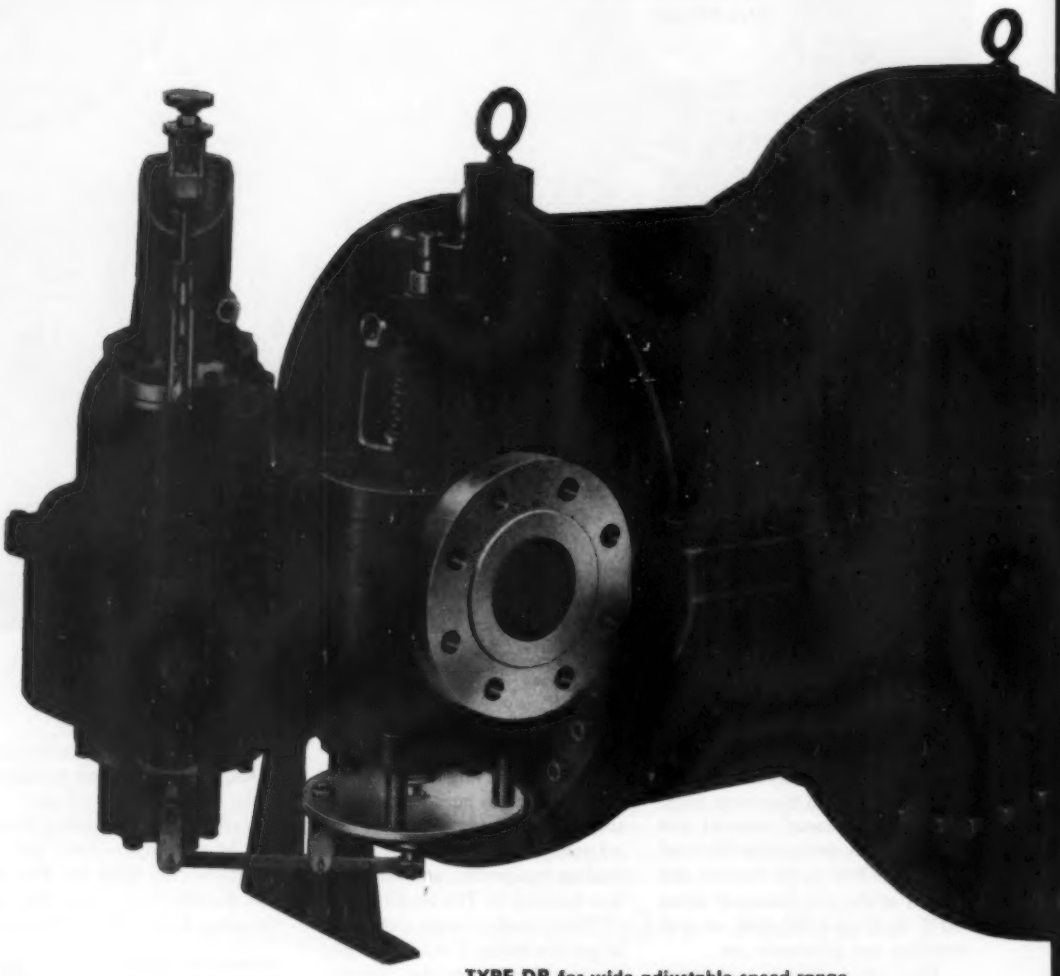
Thus Girdler's wide experience in gas processing is once again paying dividends—in the country's largest plant of its type. Elemental sulphur, vital to the mobilization effort, is produced at the rate of 300 tons a day. And the flexibility of the plant permits coordination of sulphur, gas, and oil production at the optimum over-all rate.

If efficient gas processing is necessary in your operations, put our experience to work for you, too. The Girdler Corp., Gas Processes Division, Louisville 1, Kentucky.

Write for bulletin describing our services. The Girdler Corporation designs and builds plants for the production, purification or utilization of chemical process gases; the purification of liquid or gaseous hydrocarbons; the manufacture of organic compounds.

THE GIRDLER CORPORATION
Gas Processes Division

GENERAL ELECTRIC ANNOUNCES *New*



TYPE DR for wide adjustable-speed range

Multi-Stage Turbines

Available in Four Designs—200 to 5000 hp

Now in production! General Electric's completely new, multi-stage turbine drives . . . designed to give you maximum mechanical power for every fuel dollar . . . available to meet any mechanical drive application where efficiency and reliability are "musts."

FOUR NEW TYPES—The DP, DR, DRV, DRVX—incorporate the newest ideas in improved turbine design. Four different governing systems give you a wide selection of performance ratings for either condensing, noncondensing or automatic extraction applications.

NEW FEATURES that spell increased economy and reliability are built into General Electric's new multi-stage turbines. A completely new sectional valve gear, for instance, gives you greater efficiency for part load operation. Refinements in governing, lubrication and steam chest design make these the finest mechanical-drive turbines General Electric has ever produced.

A NEW TECHNIQUE of manufacturing from standard, interchangeable patterns promises you savings in initial investment and shortened delivery time. You get a custom turbine, designed for your job, built from standard parts.

Get the full particulars on these brand new multi-stage turbine drives. Write for your copy of our new bulletin, GEA-5580, "G-E Multi-Stage Turbine Drives." Section 252-52, General Electric, Schenectady 5, N.Y.

252-52

GENERAL ELECTRIC

WHEN POWELL VALVES GO IN, MAINTENANCE GOES OUT!

With today's urgent need for maximum production, why take a chance on any valves that require constant attention?

By installing Powell Valves—built for perfect performance with minimum maintenance—you can stop worrying about your flow control equipment.

Gate, Check, Globe and Y Valves, in Bronze, Iron, Steel and Corrosion-Resisting Metals and Alloys

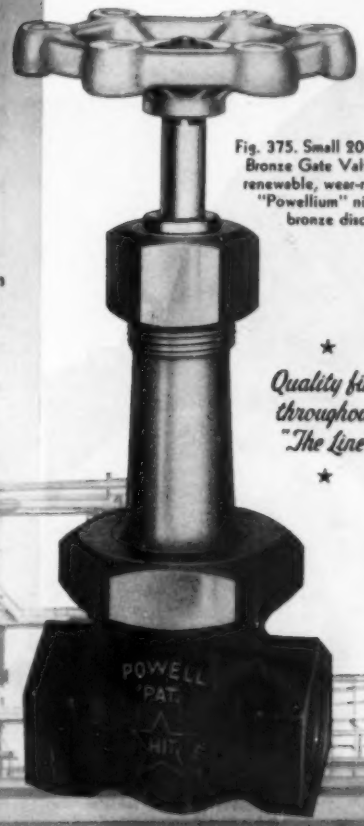
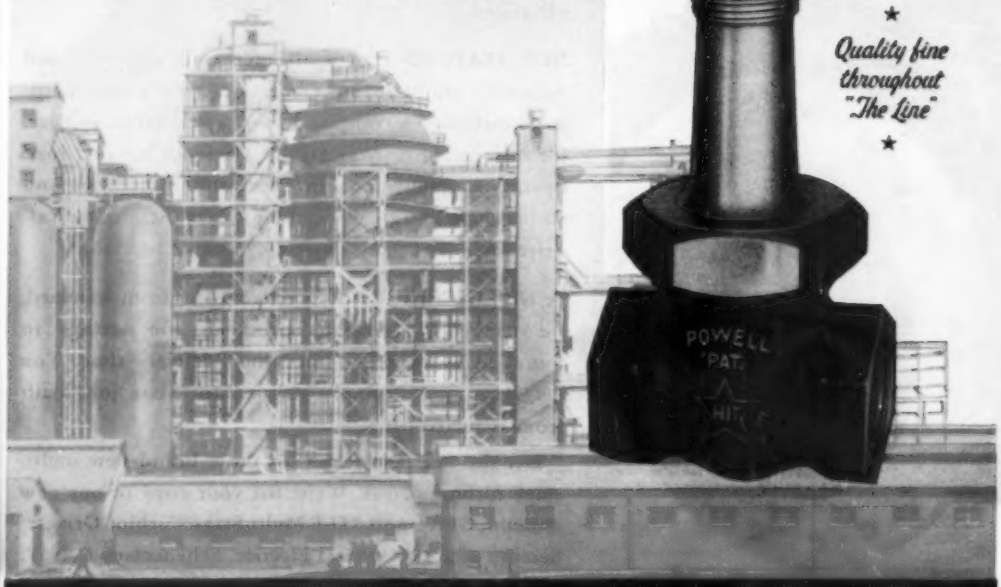


Fig. 375. Small 200-pound Bronze Gate Valve with renewable, wear-resisting "Powellium" nickel-bronze disc.

★ *Quality fine throughout "The Line"* ★



POWELL

The WM. POWELL CO., 2525 Spring Grove Ave., P. O. Box 106, Station B, Cincinnati 22, Ohio

LARGEST AVAILABLE CHOICE OF STANDARD STYLES

FURNISHED WITHOUT DIE COST

"Shop PSC First" may remind you of the slogan of one of your local department stores. Actually there is a real resemblance between the two institutions in one characteristic:— Wide Selection. The Pressed Steel Co. offers you the largest choice of standard styles of bubble caps and risers available: 200 of the most commonly specified styles. As a result PSC not only makes prompt delivery, but we also save you the cost of dies. Caps to meet special needs will be promptly designed.

PSC bubble caps and risers are fabricated from the complete list of alloys, and for any method of tray assembly. Let us show you why the majority of the industry's fractionating facilities today use PSC bubble caps. Send blue prints or write as to your needs. Also welded alloy tubing and assemblies.

Send for
BUBBLE CAP BULLETIN 21
We believe it is the largest compilation of engineering data on bubble caps and risers in printed form. Also contains drawings for use in determining methods of tray assembly.

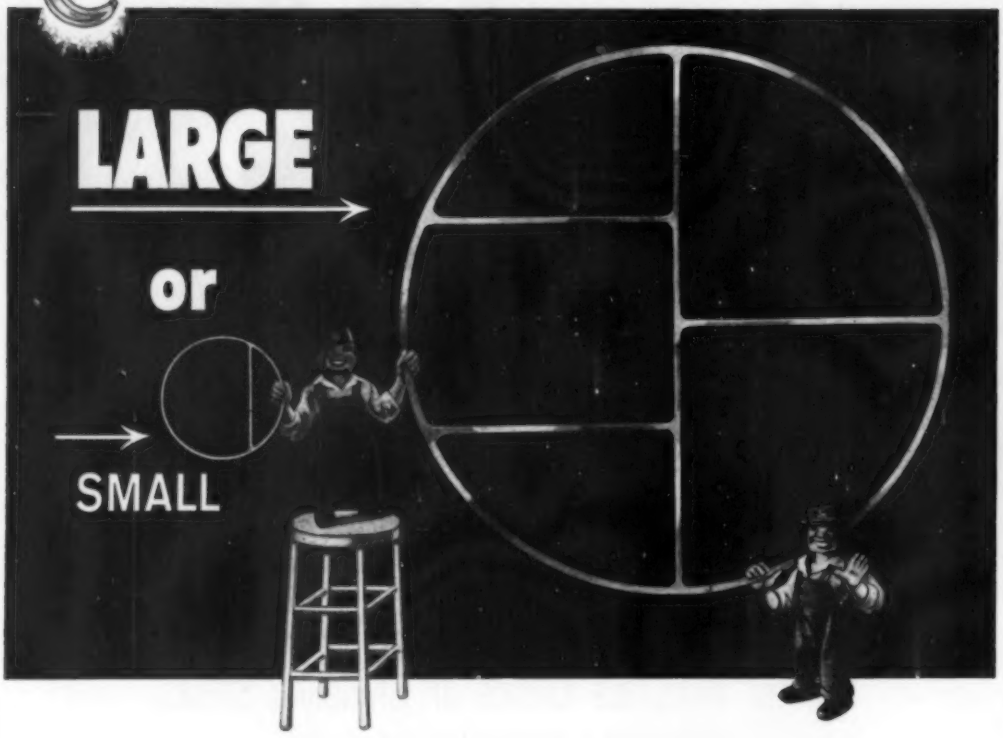
The PRESSED STEEL PSC

THE PRESSED STEEL COMPANY
of WILKES-BARRE, PENNSYLVANIA

Industrial Equipment of Heat and Corrosion Resistant WEIGHT-SAVING *Sheet Alloys*

☆ ☆ ☆ OFFICES IN PRINCIPAL CITIES ☆ ☆ ☆

Hand-tailored to any size you need...



...Goetze Heat Exchanger Gaskets are precision-made for longer service

Whether your requirements call for heat exchanger gaskets larger than 100" in diameter, or smaller than 10", you can get the exact size you want . . . hand-tailored to the shape you need . . . simply by specifying "Johns-Manville Goetze."

And because they're *precision-made*, you'll find these better gaskets provide the effective sealing and longer life that make them actually cost less in the long run. Each gasket is carefully constructed in every detail to assure accuracy of fit . . . to provide ample lap widths and uniform rib widths . . . and to prevent trouble-making wrinkles or cracks on the corners.

If you're having trouble with persistent joint leakage and frequent gasket replacements, find out how little it costs to have Goetze Heat Exchanger Gaskets tailored to your requirements. Your blueprint or template will bring a prompt estimate. Address Johns-Manville, Box 290, New York 16, New York.

Johns-Manville *Goetze* GASKETS

THERE'S A JOHNS-MANVILLE PACKING AND GASKET FOR EVERY SERVICE

Why Phosphorized Admiralty Condenser Tubes?

...OUTSTANDING RESISTANCE TO DEZINCIFICATION

Adding as little as 0.02% phosphorus to Admiralty greatly increases its resistance to dezincification, without impairing its excellent chemical and physical properties.

In refinery applications, Scovill Phosphorized Admiralty Tubes have given maximum trouble-free life, proving to be relatively immune to dezincification and in addition, highly resistant to attack by sulfides and other active sulphur compounds encountered in this service.

In order to assure *uniform* chemical composition and *soundness*, Scovill produces its Phosphorized Admiralty tubes by the *continuous* billet-casting process which continuously maintains the optimum amount of phosphorus. The tubes are hot-extruded from the continuous-cast billets, then are cold-drawn, annealed, cleaned and finished to produce tubes of uniform temper, gauge, straightness, roundness, diameters, length and freedom from burrs.

A Condenser Tube Booklet is available to qualified users who request it on their business letterhead. Scovill Manufacturing Co., 14 Mill St., Waterbury 20, Conn.

Only Scovill Phosphorized Admiralty Has All These Advantages . . .

- Uniformity and soundness resulting from Scovill continuous-casting techniques
- Relative immunity to dezincification
- High resistance to sulfides and other active sulphur compounds
- Superior performance in fresh, salt, or brackish waters
- Satisfactory resistance to weak mineral acids and acid mine waters
- Good resistance to velocities under 7 fps.
- Excellent performance at relatively high operating temperatures

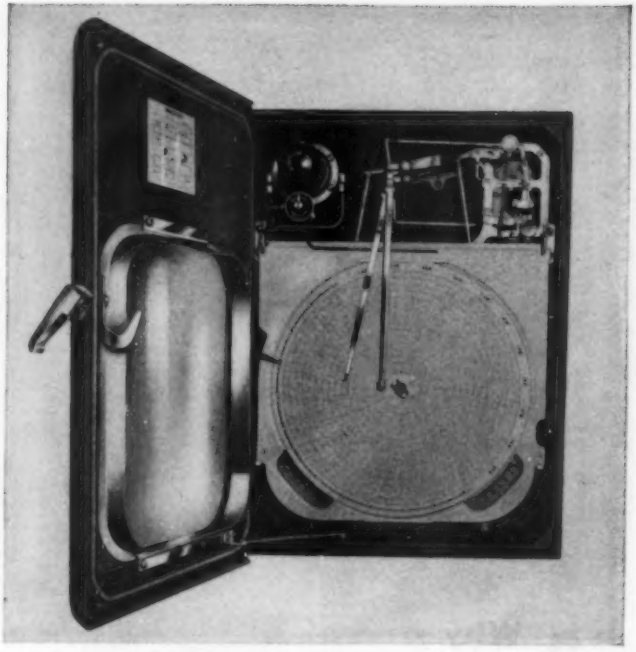
SCOVILL

A PRODUCT OF SCOVILL

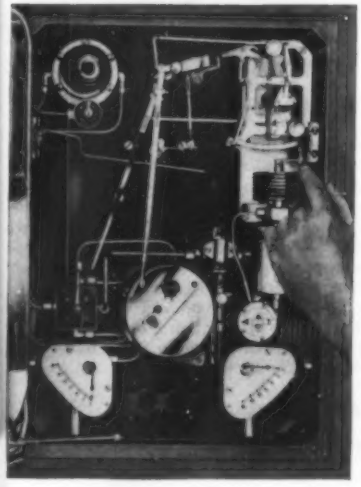
SCOVILL CONDENSER TUBES

"You can't buy better brass"

Anybody Can Take Care of a BRISTOL SERIES 500 CONTROLLER



Plant operating men quickly become familiar with it... and like to use it



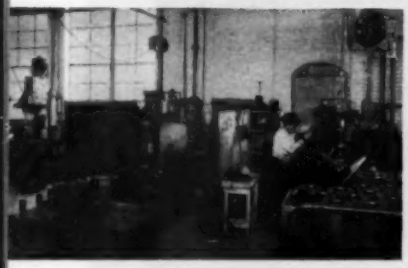
Only One Simple Adjustment

Write or call your local Bristol representative. And write for Bulletin A120. THE BRISTOL COMPANY, 111 Bristol Road, Waterbury 20, Conn.

BRISTOL

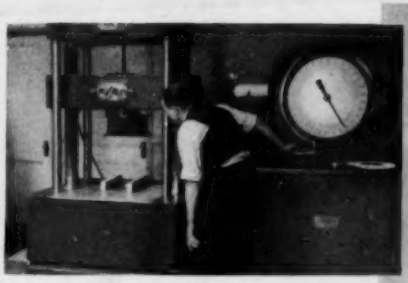
AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

Why Grinnell is America's #1 Supplier of PIPE HANGERS *and* SUPPORTS



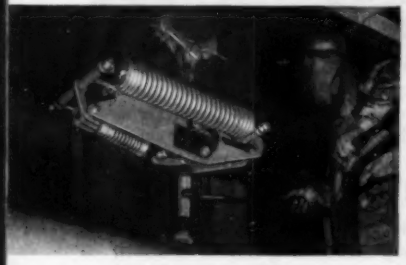
GRINNELL, ALONE, MANUFACTURES A FULL LINE OF HANGERS AND SUPPORTS

No other company, anywhere, makes a line as complete or varied. Grinnell produces hangers in thousands of combinations to support any piping.



GRINNELL, ALONE, MAINTAINS AN EXPERIENCED LABORATORY STAFF OF TRAINED TECHNICIANS

In its modern, well-equipped laboratory, tests are constantly being made to discover better ways of solving old and new pipe suspension problems.

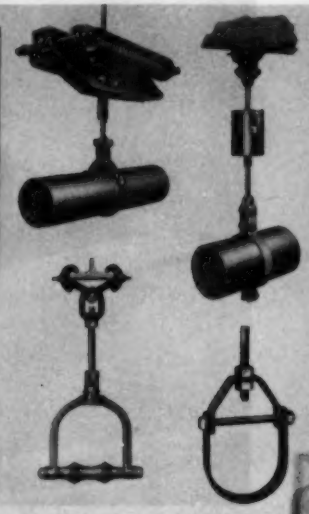


GRINNELL, ALONE, PROVIDES ENGINEERING ASSISTANCE IN DESIGN AND INSTALLATION

Grinnell makes available specialized knowledge in the computation of hanger loads and the selection of the correct supports. Engineers in the field assist with problems in erection of pipe hangers.

GRINNELL, ALONE, THROUGH ITS CONVENIENT WAREHOUSES CAN SUPPLY YOU "OUT OF STOCK"

No manufacturer of pipe hangers offers a distribution system as thorough or efficient. Grinnell warehouses are located in 30 principal cities . . . with jobbers in practically every city, coast to coast.



Grinnell makes scientifically designed, ruggedly built pipe hangers and supports for every type installation.

Pipe suspension presents an extremely wide range of problems involving weights, stress, thermal movement, materials and specialized engineering. No one "goes into" the pipe hanger business overnight. Large manufacturing facilities, skilled technicians, and a lot of down-to-earth practical experience are needed.

Grinnell has become America's No. 1 supplier of pipe hangers and supports only because Grinnell has specialized in piping for one hundred years. Grinnell has developed a line of pipe hangers and supports for every piping requirement, from the simplest to the most complex.

Grinnell is always ready to co-operate with engineers and architects in the preparation of pipe suspension specifications.

Call Grinnell for any and all types of pipe hangers and supports.

GRINNELL

WHENEVER PIPING IS INVOLVED

Grinnell Company, Inc., Providence, Rhode Island • Sales Offices and Warehouses in Principal Cities

pipe and tube fittings • welding fittings • engineered pipe hangers and supports
Thermolier unit heaters • valves • Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies • industrial supplies
Grinnell automatic sprinkler fire protection systems • Amco humidification and cooling systems

THEY DON'T GIVE FIRES A CHANCE TO GET AHEAD!

Deluge Systems, Wet Pipe Systems, Dry Pipe Systems, Water Spray and Fog Systems, Rate-of-Rise Sprinkler Systems, and Foam and Carbon Dioxide Extinguisher Systems.

"LITTLE JOEY SPRINKLER"
Always on the job

Volatile liquids, once ignited, don't wait for the Fire Department. You'll have a raging inferno on your hands in minutes unless the point of origin is quenched in seconds.

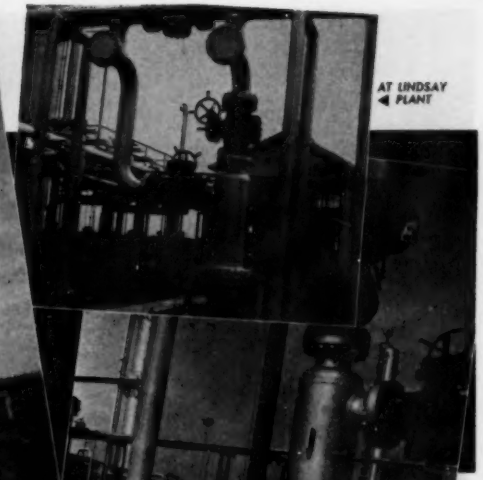
BLAW-KNOX FOG SYSTEMS

with rate-of-rise thermostats are always ready for instant action. At the first indication of dangerous temperatures they sound an alarm and start a dense, quenching fog of water to the "hot spot." Rapid dissipation of heat prevents the development of high temperatures, possible bursting pressures, and confines the damage to a small area. Blaw-Knox Fog Nozzles have no screens to clog, do not require treated water and maintain their effective spray pattern even at reduced pressures.

At your request a Blaw-Knox Engineer will make a survey of your fire hazards, secure your insurance underwriter's requirements, prepare a preliminary layout of a system that will give you the utmost in fire protection, and submit an estimate of costs—all without obligation.

BLAW-KNOX SPRINKLER DIVISION of Blaw-Knox Construction Company
829 Beaver Ave., N.S., Pittsburgh 33, Pa.
Offices in Principal Cities

Blaw-Knox AUTOMATIC FIRE PROTECTION SYSTEMS



Staynew FILTERS

in the New Garvin County Plants Protect Compressors, Prevent Injection Well Plugging!

Here, in one of the newest and largest operations of its kind in the entire world, Staynew Filters provide all-important protection for equipment and processing.

In each plant, a Staynew Model HPH Filter removes aluminum oxide generated in the dehydration process from approximately 40 million cu. ft. of gas per day. This aluminum oxide, in the form of an abrasive powder, would cause serious damage if allowed to pass steadily into the lines and equipment which subsequently handle the gas.

In the Antioch Plant, where dehydrated gas is re-pressured to 2400 lbs. and injected into the reservoir, the Staynew Filter not only positively protects the 3 extra re-pressuring compressors against excessive wear, but prevents the pores of the oil-bearing sand from becoming plugged with aluminum oxide.

All Plants Operate Night and Day the Year Around

Such continuous operation would ordinarily require dual installations. However, due to the exclusive Staynew design, a *single filter* only was required at each plant. A by-pass is provided for use during the time required for cleaning or replacement of inserts. Experience indicates that such servicing is not necessary oftener than twice a year, and that only two hours is required for the operation!

This group of filters represents only one of the thousands of Staynew installations in critical service throughout industry. As a result of the many problems solved during these installations, an unsurpassed fund of information in this specialized field has been acquired. For help in solving *your* filtration problems, contact your Dollinger representative, or write direct, care of Dollinger Testing Laboratory.

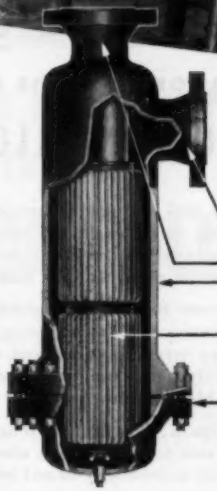


Diagram and Specifications of STAYNEW FILTERS in Service at Garvin County Plants

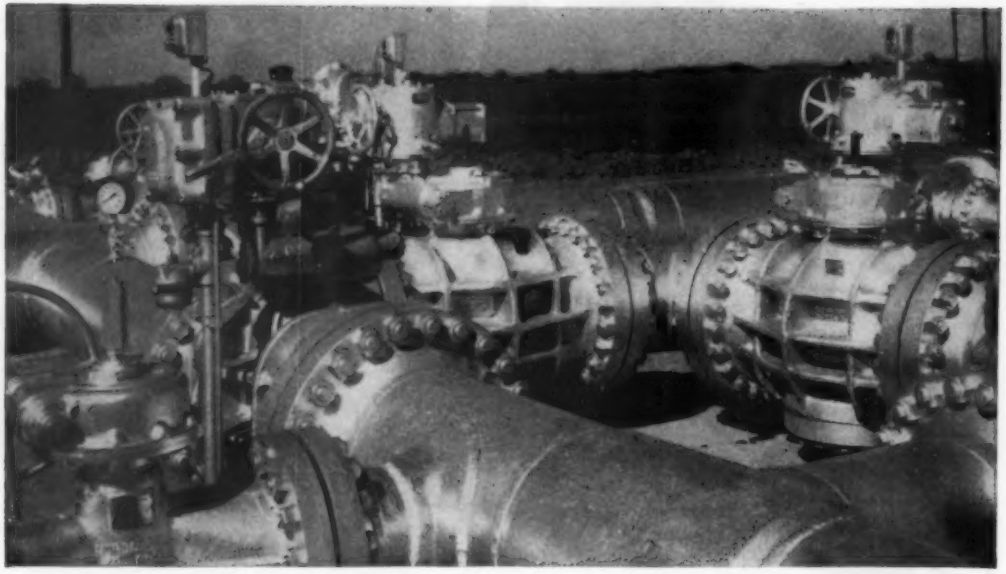
- Inlet.
- Outlet.
- Forged steel shell, 7/8 in. thickness, certified for 800 lbs. pressure.
- Radial Fin Filter Inserts. Removable by simply unscrewing wingbolt after unbolting head.
- Bolted Head, 32 in. x 3½ in. flanges.

Wt. 3425 lbs.

DOLLINGER CORPORATION

47 CENTRE PK., ROCHESTER 3, N. Y.

DOLLINGER PROTECTOMOTOR U.S. PAT. OFF. STAYNEW FILTERS



STUD JOINTS ARE STRONG POINTS

...when connections are made with

REPUBLIC UPSON ALLOY STEEL STUDS

These tough alloy steel studs get a vise-tight grip—and hold it! Roughest operating conditions can't make them relent. They take stress and strain in easy stride . . . successfully resist high temperatures, extreme pressures, rust and corrosion.

No job is too severe for these "toughies." They render long, reliable service. Precision-made and strong all the way through, they'll take heavy wrenching without slipping or stripping . . . turn off as readily as they went on, when lines must be opened for purging and blowing down.

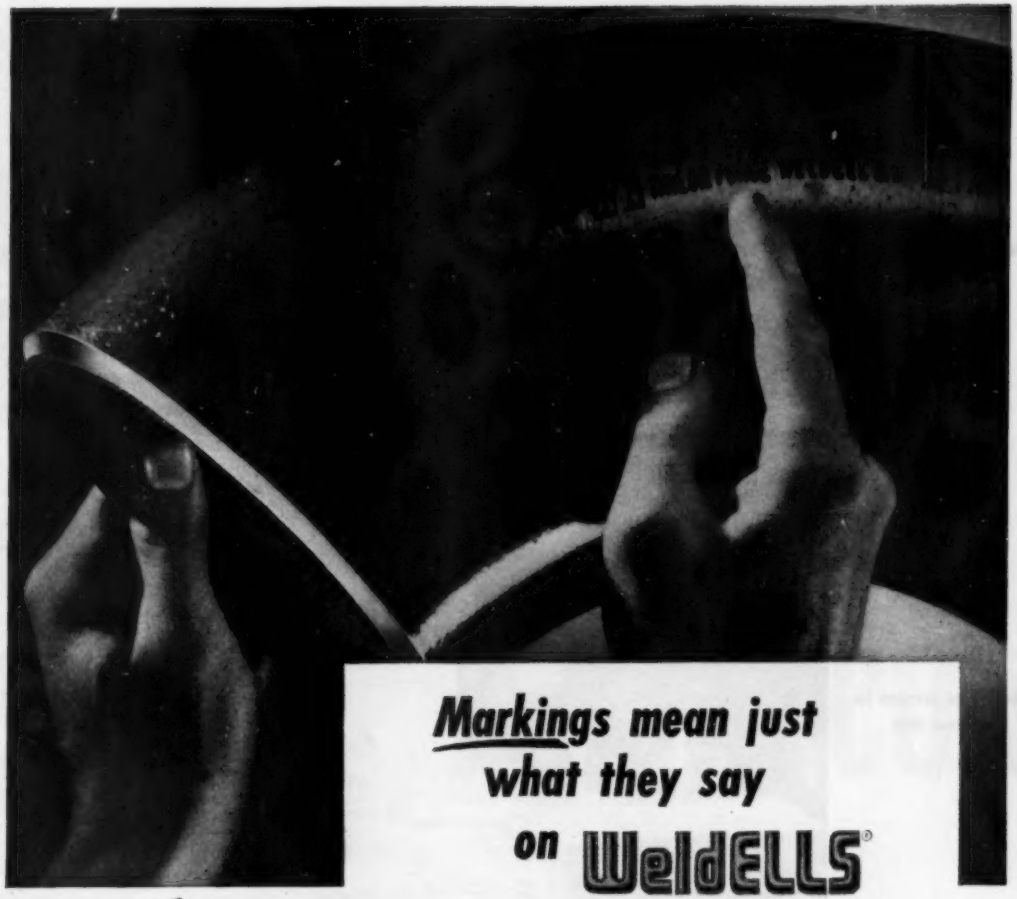
Install Republic Upson Alloy Steel Studs next time you make stud replacements. Be sure to specify them when buying new equipment. It will pay you in trouble saved and lower maintenance costs.

REPUBLIC STEEL CORPORATION
BOLT AND NUT DIVISION • CLEVELAND 13, OHIO
Export Department: Chrysler Building, New York 17, N. Y.

Made from Alloy Steel — from the furnaces of Republic, world's leading alloy steel producer.

REPUBLIC *Upson Quality* BOLTS AND NUTS

Other Republic Products Include Machine, Tank and Carriage Bolts—Lag Screws, Cap Screws and Rivets



Markings mean just what they say on WeldELLS®

A VOLUME OF USEFUL DATA ON A SINGLE SHEET—Sizes, thicknesses and dimensions of all commonly used WeldELLS and Taylor Forged Steel Flanges ingeniously condensed on a heavy durable, letter-sized card. Indispensable for piping men. Coupon brings free copy.

No other fittings for pipe welding are so true to their markings as WeldELLS — so absolutely uniform, mechanically, metallurgically, dimensionally.

It would be bad business for us to say this if thousands of users had not already said it for us and to us. "There are no bad ones" is nearly always the foremost reason given by practical men for insisting on WeldELLS.

Pick up any WeldELL and check it against the tabulation of its size, wall thickness, and other dimensions. It will be right on the head. And it will be right on the head in plus-value features, too—features that are combined in no other fittings.

Remember that the finest line of welding fittings is also the broadest line. Coupon brings your copy of useful data described below.

TF

TAYLOR FORGE

TAYLOR FORGE & PIPE WORKS
General Offices and Works: P. O. Box 485, Chicago 90, Ill.
Offices in all principal cities
Plants at: Carnegie, Pa.; Fontana, Calif.; Hamilton, Ont., Canada

Please send a copy of your data sheet covering Taylor Forge Welding Fittings and Forged Steel Flanges.

NAME_____

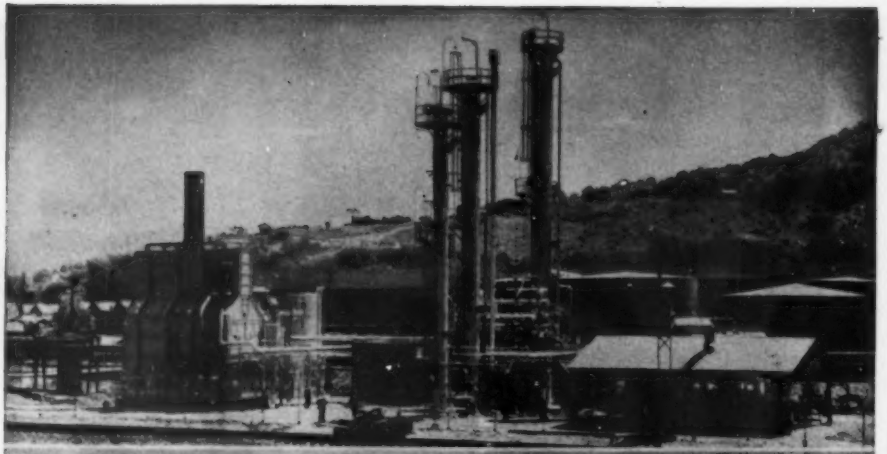
POSITION_____

COMPANY_____

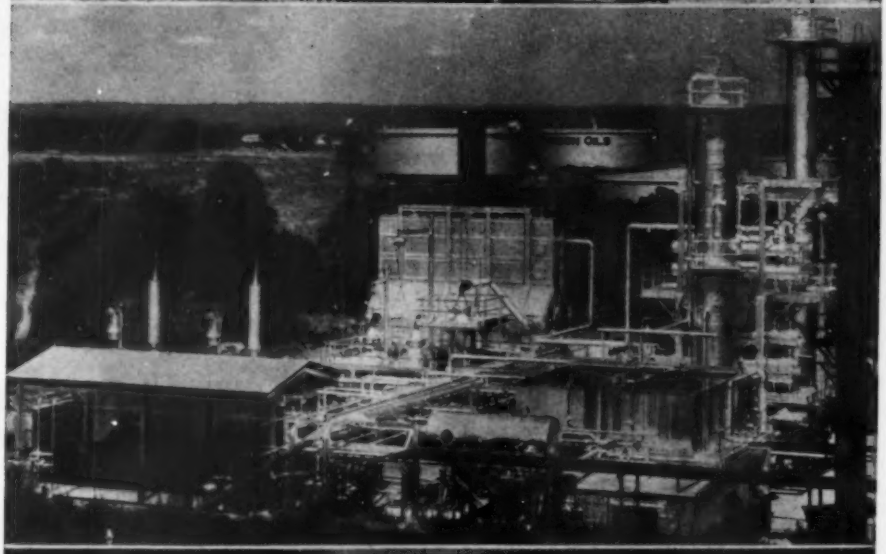
STREET ADDRESS_____

CITY_____ ZONE____ STATE_____

507-1051 Mail to Taylor Forge & Pipe Works, P. O. Box 485, Chicago 90, Ill.



KENDALL REFINING CO.
Bradford, Pa.



JOHNSON OIL REFINING CO.
Cleveland, Okla.

MIDWEST REFINERIES, INC.
Alma, Michigan

NOW ON STREAM... THREE NEW UOP PLATFORMING UNITS

On stream in less than a year from the date the contracts were signed . . . the new Kendall, Johnson, and Midwest Platforming Units provide proof of Procon resources and skill.

Even though defense requirements presented definite problems, Procon was able to procure materials and equipment without serious delay . . . and having ample manpower and construction facilities available, quickly completed the jobs.

BUILT BY PROCON

Staffed and equipped to handle any process construction job, Procon offers a *complete service* to the petroleum refining and petro-chemical industries. If your plans call for new construction or expansion of existing facilities, discuss your requirements with Procon.

PROCON *Incorporated*

PROCESS CONSTRUCTION

75 EAST JACKSON BLVD., CHICAGO 4, ILLINOIS

NON-LUBRICATED
VAPOR-TIGHT PLUG
VALVE

KEROTEST
GENERAL

TWIN SEAL

Operates in 1¼ turns
NO! NO! No Lubrication
Retracting seats can't score walls
Facings as specified
Shuts off VAPOR TIGHT
235 to 5,000 P.S.I. Working Pressures
Easy to Remove this Plate to Change Seating Slips
KEROTEST

KEROTEST

KEROTEST MANUFACTURING COMPANY
2525 LIBERTY AVENUE • PITTSBURGH 22, PA.

LOS ANGELES • CHICAGO • CHARLESTON • ODESSA • TULSA • HOUSTON • NEW YORK

News for the Southwest

ALCO Exchangers, now built in Texas

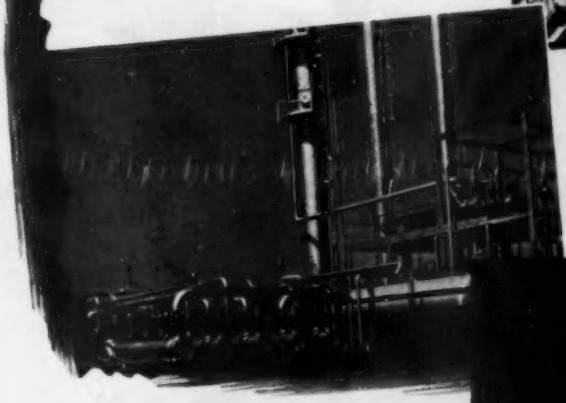
faster service, greater convenience, more time saved

At the **Beaumont Iron Works,** in the heart of the Southwest, engineers and designers who know oil, and understand its requirements, are now building ALCO heat exchangers. To the quality and dependability of these exchangers is now added the advantages of a strategic location—savings in time and greater convenience.

Put these extra values to work for you by calling in the ALCO-BIW representative when you need heat exchangers. The Beaumont Iron Works Company—Beaumont, Texas—is a subsidiary of the American Locomotive Company.

SPECIAL EXCHANGER EQUIPMENT. For years ALCO has successfully handled the problems connected with large or special heat exchanger equipment.

CAREFUL CONSTRUCTION. ALCO's long years of experience are your guarantee of quality that's built into every one of these heat exchangers.



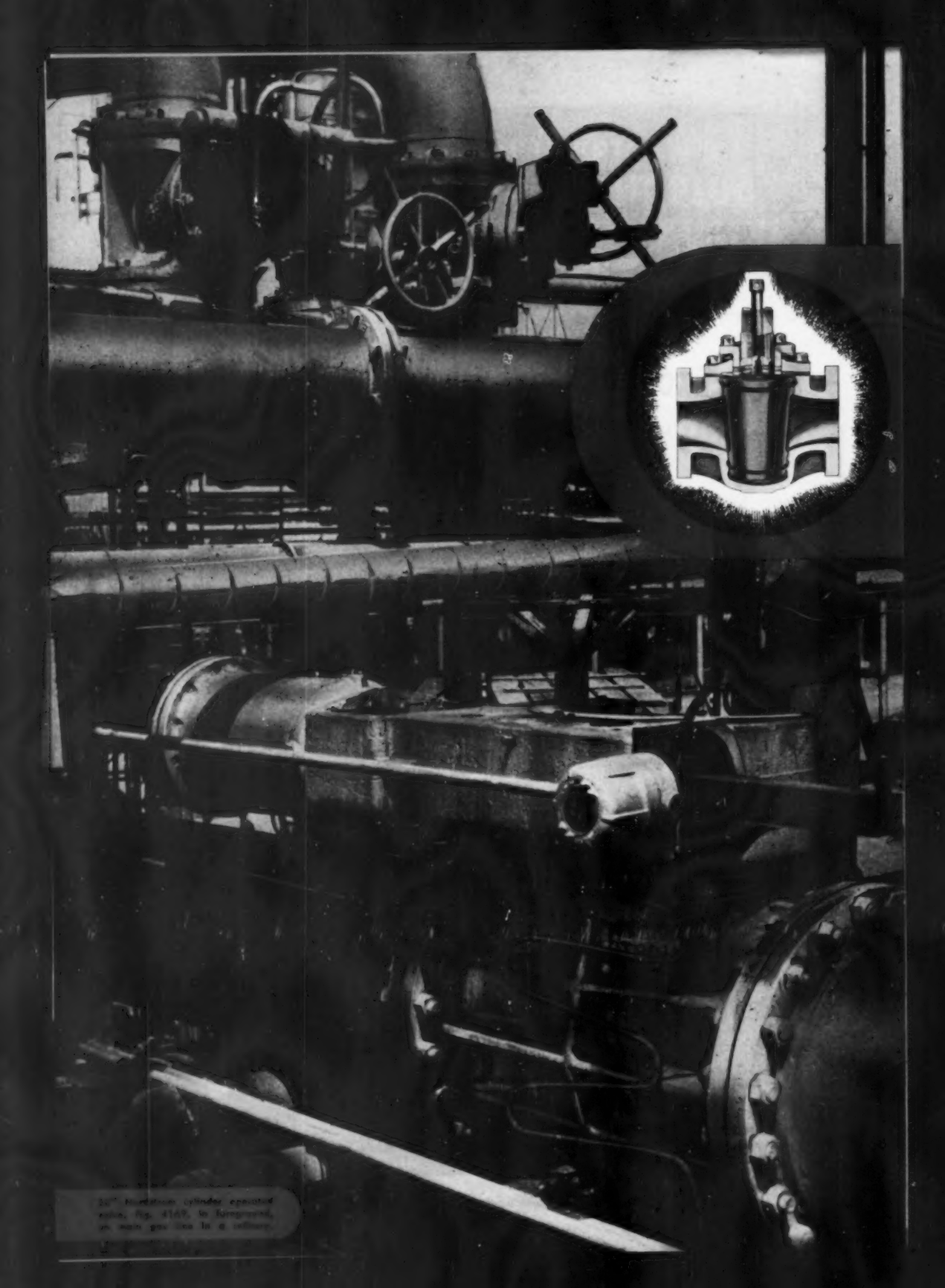
PROVEN PERFORMANCE. In numerous installations like this large Southwestern natural gasoline plant ALCO exchangers prove their mettle in the toughest test of all—actual operation in the field.

ALCO

ALCO Products Division

AMERICAN LOCOMOTIVE COMPANY

***In step with tomorrow*—ALCO AIRCOOLERS, Heat Exchangers, Evaporators, Feedwater Heaters, Pressure Vessels, Pipe**



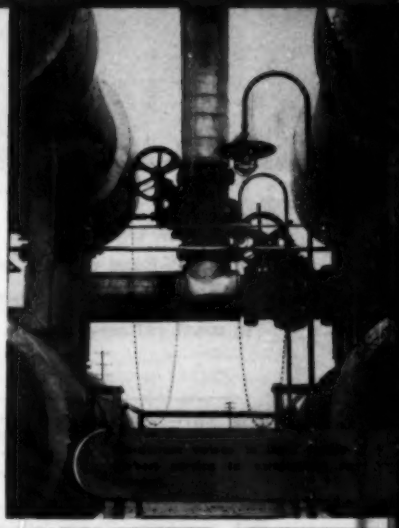
Nordstrom Valves INSURE

TREMENDOUS SAVINGS IN MAINTENANCE COSTS

throughout refining processes....

Getting right down to dollars, Nordstrom valves save refining costs in a multiplicity of ways. *First*, consider their longer life, which means fewer replacements and less investment over the years. *Second*, consider their big saving in man-hours. By using Hypermatic, the valves are *automatically* lubricated and maintain a condition of 100% lubrication for extremely long periods of time. *Third*, consider their incomparable performance. No sticking, no breakage, no leakage. And *fourth*, consider their low repair cost, which over a 20-year period has averaged less than ½ of 1% of the initial valve cost.

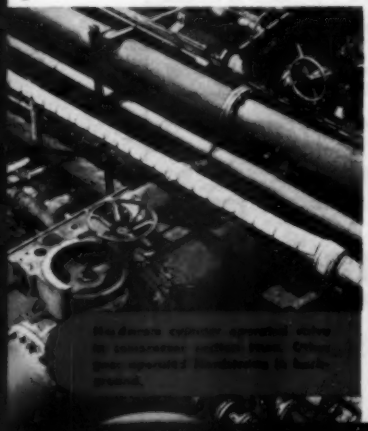
Make it a habit to install Nordstrom valves as replacements for all your old troublesome valves. Go modern with Nordstroms. Keep upkeep down.

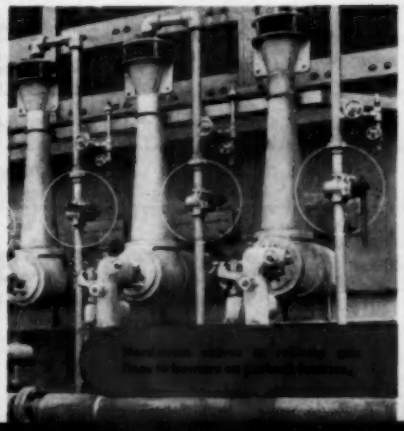


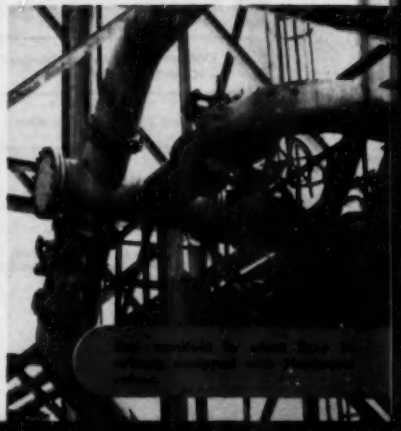
Rockwell MANUFACTURING COMPANY

400 N. Lexington Ave., Pittsburgh 8, Pa.

Atlanta, Boston, Chicago, Columbus, Houston, Kansas City, Los Angeles, New York, Pittsburgh, San Francisco, Seattle, Tulsa ... and leading Supply Houses. *Export:* International Division, Rockwell Manufacturing Company, 7701 Empire State Bldg., New York 1, N. Y.

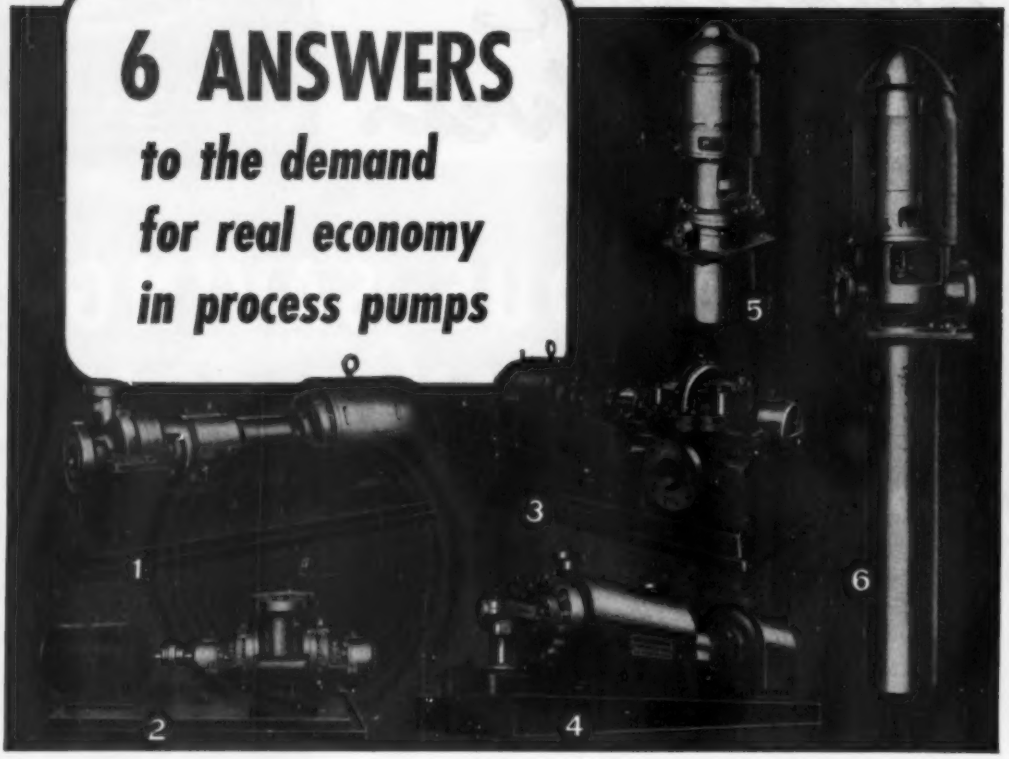






6 ANSWERS

to the demand for real economy in process pumps



These six types of Ingersoll-Rand process pumps offer you important savings in most refinery jobs.

For most refinery and process plant applications, there's an Ingersoll-Rand pump that is right for the job. This means more than just meeting design conditions – it means construction of the *right* materials and the *right* sealing arrangement, with either the Cameron Shaft Seal or an adaptation of a packed stuffing box. These and other points of pump know-how can only be gained through years of field and design experience – experience which Ingersoll-Rand has had in over 50 years of service to the petroleum industry.

Let your nearest I-R representative give you the details on the real economy of I-R pumps – high sustained efficiency, economical operation, and low maintenance.

	PUMP TYPE	STAGES	CAPACITIES	HEAD
1	Vertically split with top (or bottom) suction and discharge or end suction and top discharge	Single stage	20 to 3200 gpm	Heads to 600 feet
2	Vertically split with top suction and discharge	Single stage	250 to 3500 gpm	Heads to 1100 feet
		Two stage	200 to 1200 gpm	Heads to 1100 feet
3	Horizontally split with side suction and discharge	Single stage	30 to 2300 gpm	Heads to 750 feet
		Two stage	170 to 1300 gpm	Heads to 1100 feet
4	Diffusor type with "double-case" construction. Top suction and discharge.	Multi stage	450 to 3000 gpm	Heads to 6000 feet
5	Vertical pump, diffusor type	Multi stage	20 to 400 gpm	Heads to 4800 feet
6	Vertical pump, turbine type	One or more stages	60 to 35,000 gpm	Heads to 150 feet per stage

Compressors • Air Tools • Rock Drills
Turbo Blowers • Condensers • Centrifugal Pumps
Diesel and Gas Engines

Ingersoll-Rand

11 Broadway, New York 4, N. Y.

589-10

GARLOCK METAL FOIL PACKINGS

GARLOCK Metal Foil Packings are specially designed for service on rods or shafts of equipment operating at high speeds and high temperatures.

They are constructed of thin metal foil spirally wrapped around a fibrous center core. Thus, the durability of metal wearing surfaces is combined with the resiliency of a fibrous packing.

The packings described at the right have a patented, pleated foil construction which makes them remarkably flexible and permits the forming of rings without undue distortion of the material. Also, the many small pockets in the pleats of the foil carry lubricant to the wearing surfaces of the packing. Write for descriptive folder.

COPPER GARLOCK 906—Pleated copper foil with asbestos core for steam, air or gases (except ammonia) and hot oils of low sulphur content, at temperatures up to 1000° F.

ALUMINUM GARLOCK 913—Pleated aluminum foil with asbestos core for hot oils at temperatures up to 1000° F.

LEAD GARLOCK 917—Pleated lead foil with asbestos core for steam, air, oil, water, ammonia or other gases at temperatures up to 550° F.

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK

Tulsa, Okla. Houston, Tex.
Los Angeles, Calif.

GARLOCK PACKINGS, GASKETS AND OIL SEALS

Filter plant, Freedom Valvoline Oil Company, Freedom, Pa. Roofing and siding are "Century" Asbestos-Cement Corrugated. Erection Contractors: Elwin G. Smith & Company.

THIS modern filter plant of the Freedom Valvoline Oil Company, Freedom, Pa. is typical of the many progressive industrial plants throughout the nation where "Century" Corrugated Asbestos-Cement Sheets have been used for both roofing and siding.

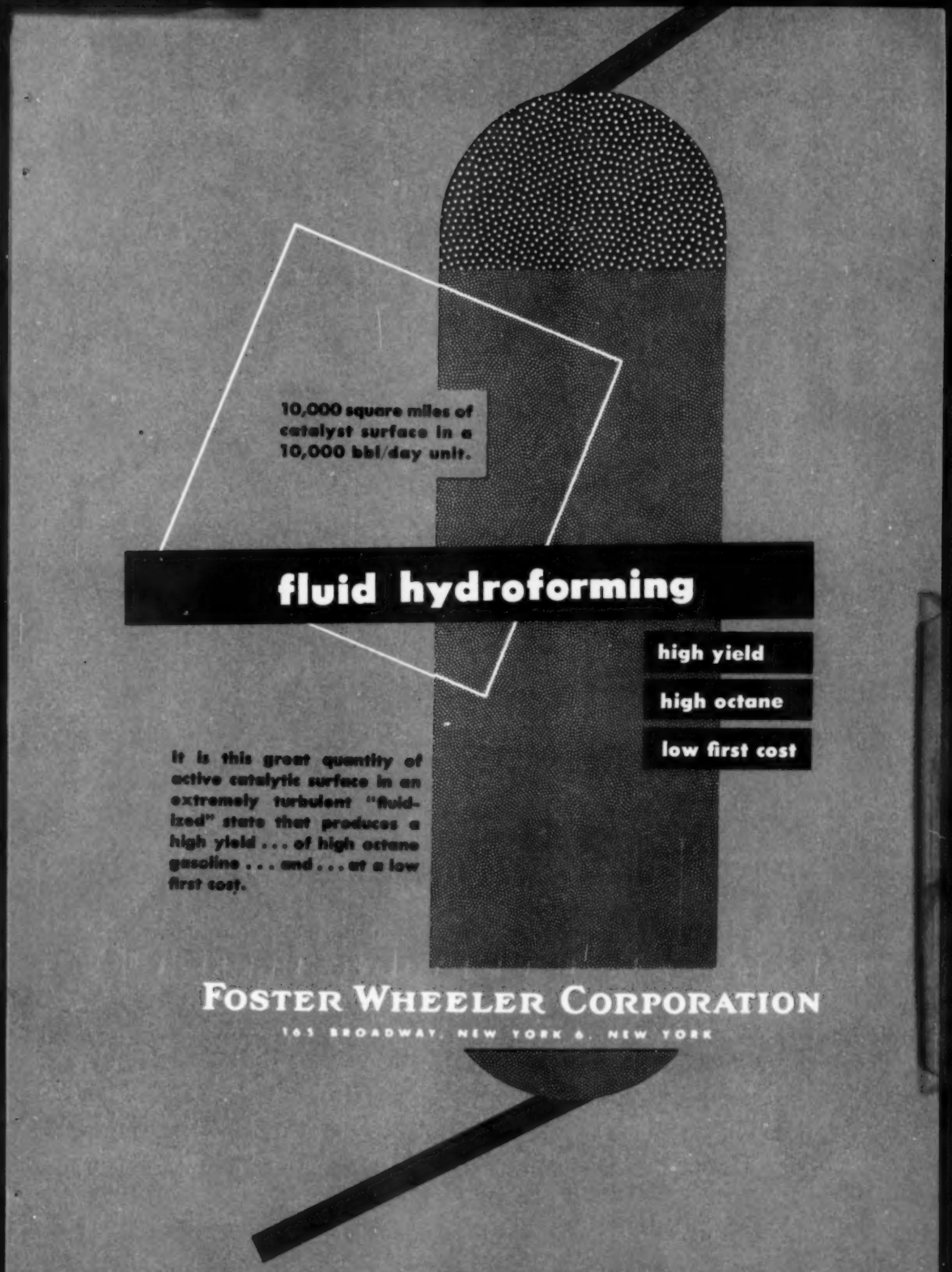
The choice of "Century" Asbestos Corrugated is a logical one wherever quick application and maintenance-free service are desired. "Century" Asbestos Corrugated goes on quickly, inexpensively. The large-size sheets are exceptionally strong, but they can be cut and drilled easily—fastened in place with a minimum of labor.

And the protection is permanent! "Century" Asbestos Corrugated resists weather; *can not burn*, rot, or rust. Rodents and termites can't hurt it. It doesn't even need protective painting to preserve it!

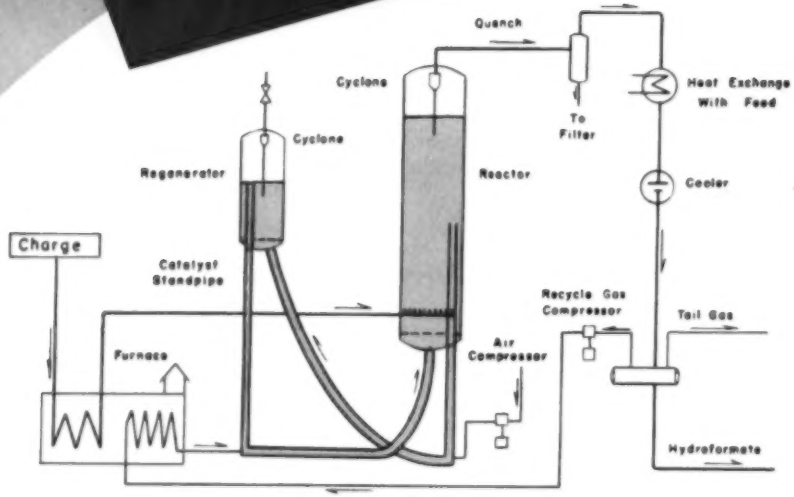
Whatever your building plans—new construction, modernization, expansion—get the cost-saving story of "Century" Corrugated Asbestos-Cement Sheets. We'll gladly send complete data on request.

Nature made Asbestos...
Keasbey & Mattison has made it serve mankind since 1873

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA


10,000 square miles of catalyst surface in a 10,000 bbl/day unit.
fluid hydroforming
high yield
high octane
low first cost
It is this great quantity of active catalytic surface in an extremely turbulent "fluidized" state that produces a high yield . . . of high octane gasoline . . . and . . . at a low first cost.
FOSTER WHEELER CORPORATION
165 BROADWAY, NEW YORK 6, NEW YORK

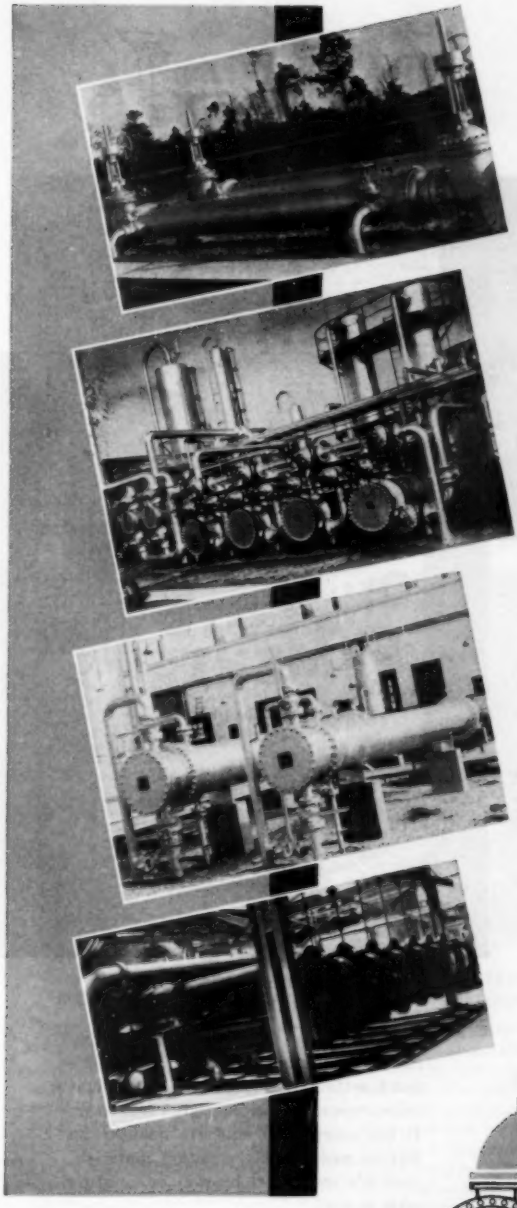
fluid hydroforming



The "fluid" principle, as applied to hydroforming, provides all the distinct advantages of full, continuous operation. Its inherent process variables also makes possible a more exact control of the intensity of the hydroforming reaction.

Foster Wheeler's Fluid Hydroforming Pilot Plant is available for stock evaluation and determination of process design data.

FOSTER WHEELER CORPORATION
165 BROADWAY, NEW YORK 6, NEW YORK



Acceptance is the real test of Performance

WESTERN
HEAT TRANSFER EQUIPMENT

Within a relatively short period of 15 years the Western Supply Company of Tulsa has gained national recognition as designers and fabricators of heat transfer equipment for the petroleum, pipe line, chemical processing, and natural gas industries.

The widespread use of Western telescopic exchangers, atmospheric sections, shell-and-tube exchangers, and reboilers, has once again proved that the real test of any equipment is in its acceptance by industry.

Western has gained this acceptance by always doing the job just a little bit better than seemed necessary. Close adherence to rigid engineering codes and specifications . . . modern, up-to-date fabricating equipment . . . trained, experienced personnel . . . plus a willingness to work cooperatively with the customer — these are the elements of PERFORMANCE that have assured industry ACCEPTANCE of Western produced heat transfer equipment.

We invite you to consult with us on all your heat exchanger needs. Detailed information on our fabricating facilities will gladly be forwarded upon your request.

Mid-Valley Pipe Line Co.
American Republics Corp.
Sunray Oil Corp.
Celanese Corp. of America

WESTERN
HEAT EXCHANGERS

Manufactured by
WESTERN SUPPLY COMPANY
P.O. BOX 1888 TULSA, OKLAHOMA
SALES OFFICES — DALLAS — HOUSTON

There's an

Eagle-Picher Insulation

that can help you control

temperatures accurately...economically!

Here's just one of the many efficient, economical Eagle-Picher Insulations. It's Eagle-Picher one-coat, all-purpose cement—a revolutionary new product that combines insulating and finishing materials ...that goes on in one easy-to-apply coat.

It gives your equipment highest possible thermal efficiency . . . cuts operating costs by saving fuel . . . and helps to provide perfect, precise control on temperatures.

Whatever your requirements . . . there's an Eagle-Picher Insulation that can fit your needs. Find out about them right away!

THESE EAGLE-PICHER PRODUCTS CAN SAVE YOU MONEY . . . POWER . . . TIME

Insulating Felts • Supertemp Blocks • Blankets
Loose Wool • Pipe Covering • Stalastic
Insulseal • Insulstic • Swetchek • Finishing Cements • Insulating Cements • Fireproofing Cement • Diatomaceous Earth Blocks

EAGLE-PICHER ONE-COAT, ALL-PURPOSE CEMENT!

A combination insulation and finishing material for temperatures to 1000 F. It's quick setting, rust-inhibitive . . . has light color, smooth surface, negligible shrinkage. It has exceptional adhesive qualities on ferrous metals and insulation materials. And it's unaffected by rain or moisture after it sets!

EAGLE EP PICHER

THE EAGLE-PICHER COMPANY • *General Offices: Cincinnati (1), Ohio*

Insulation products of efficient mineral wool — for a full range of high and low temperatures.

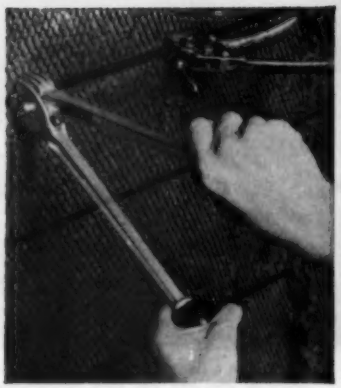
Technical data on request.

Since 1843.

2172

These efficient, versatile insulations "team up" to give perfect insulation for every major application

For a completely effective, low-cost insulation combination, you can't beat the teamwork of Eagle-Picher Mineral Wool Blankets, Supertemp Blocks, Diatomaceous Earth Blocks and Earth Fill, and Super "66" Cement. They work effectively to give your equipment highest possible thermal efficiency . . . cut operating costs by saving the maximum amount of fuel . . . and help to provide perfect, precise control over temperatures.



EAGLE-PICHER MINERAL WOOL BLANKETS

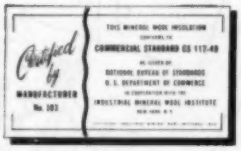
These blankets satisfy the need for a convenient method of quickly and efficiently insulating flat or curved surfaces on larger types of heated equipment. Mineral wool is felted and secured between flexible metal fabric. Outstanding physical and chemical stability enables Eagle-Picher Blankets to resist water, steam, corrosive fumes and normal vibration.

EAGLE-PICHER SUPERTEMP BLOCKS

Eagle-Picher Supertemp Blocks are lightweight (approximately 16 lbs. per cu. ft.). Can be cut easily with knife or saw to fit off-shaped areas . . . they fit snugly over minor irregularities. They're strong and have high refractory value. Withstand temperatures up to 1700 F. Conductivity at 512 F. approximately 0.53 . . . all standard sizes, from 2" x 18" to 12" x 36" in thicknesses from 1" to 4".

EAGLE-PICHER SUPER "66" INSULATING CEMENT

Super "66" is all-purpose, rust-inhibitive, extremely adhesive insulating cement. "Springy ball" pellets don't collapse after application . . . give great coverage, retain their thermal efficiency. 100 lbs. covers approximately 55 sq. ft. —1 inch thick. Easily applied with trowel, over flat and irregular surfaces. Efficient for temperatures up to 1800 F. Reclaimable when used on equipment whose temperatures do not exceed 1200F.



Eagle-Picher, as a member of the Industrial Mineral Wool Institute, urges that you look for this label. It is a certification by the manufacturer that his mineral wool product conforms to Commercial Standard CS 117-49 as issued by National Bureau of Standards, U.S. Department of Commerce in cooperation with the Industrial Mineral Wool Institute, New York, N.Y.

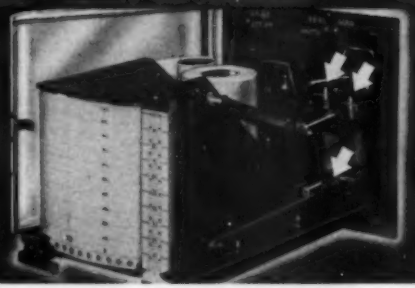
Important Contribution to

Introducing...

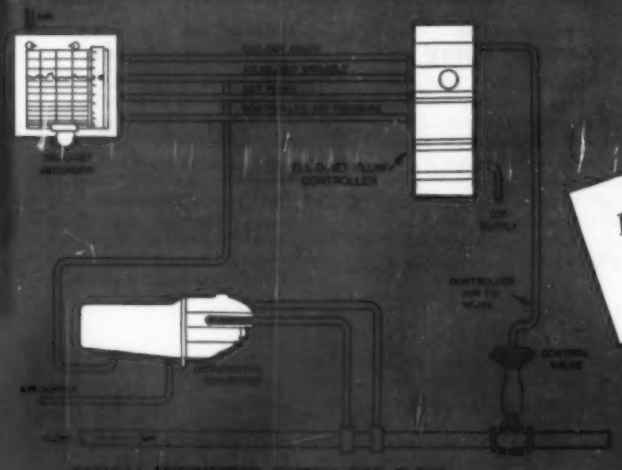
The New TEL-O-SET

8-hour chart visibility without interrupting operations

Built-in adjustable restrictions for pulsating flow



Right side of recorder, illustrating accessibility of zero and fine span adjustments.



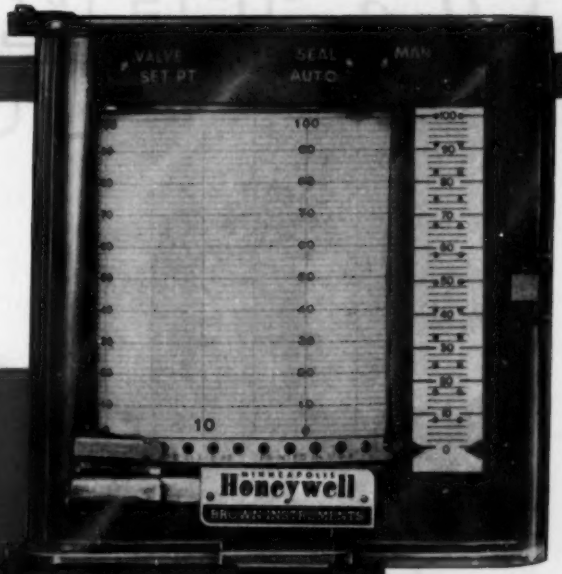
TYPICAL ENGINEERED SYSTEM FOR FLOW

The Tel-O-Set Recorder pictured in this diagram is one unit of the family . . . each part designed and built as an engineered, integrated loop.

Requires very little panel space... no holes to drill

All adjustments made at front of panel

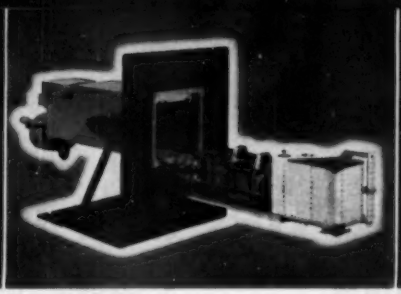
Process Control



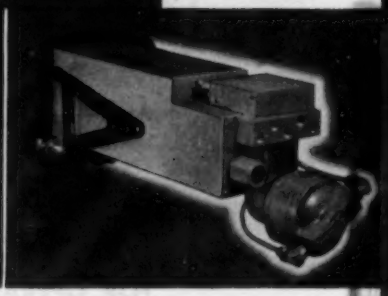
Front view showing transparent plastic cover. Knob at bottom is for adjustment of controller set point when on "automatic," and for regulation of air-to-valve pressure when on "manual." Panel space 5 1/16" high by 5" wide.

RECORDER

Left side of recorder with chassis partially withdrawn and held by safety catch. Note clearly visible 8-hour chart.



Safety catch released, chassis completely withdrawn from case. Air and electrical connections are still intact.



Rear view, showing one of the two detachable side mounting brackets with its single clamping screw.

The new *Tel-O-Set* Recorder, one of an integrated family of instruments, is used for recording such process variables as temperature, pressure, flow and liquid level. It also provides remote set-point adjustment and valve position indication.

Among the many advantages the *Tel-O-Set* Recorder offers are:

- EASE OF MAINTENANCE. Several models are available —all with interchangeable parts.
- ALL ADJUSTMENTS FROM FRONT OF PANEL. Chassis can be partially withdrawn. Zero, coarse and fine span adjustments, and restriction screws are accessible. Unit is in position for easy chart replacement and pen and ink service.
- FULL 8-HOUR CHART visible by sliding chassis only part way while instrument is still in operation.
- PILOT-OPERATED NON-DRIFT PRESSURE REGULATOR.
- BUMPLESS SHIFTING FROM AUTOMATIC TO MANUAL OPERATION.
- BUILT-IN ADJUSTABLE RESTRICTIONS FOR PULSATING FLOW.

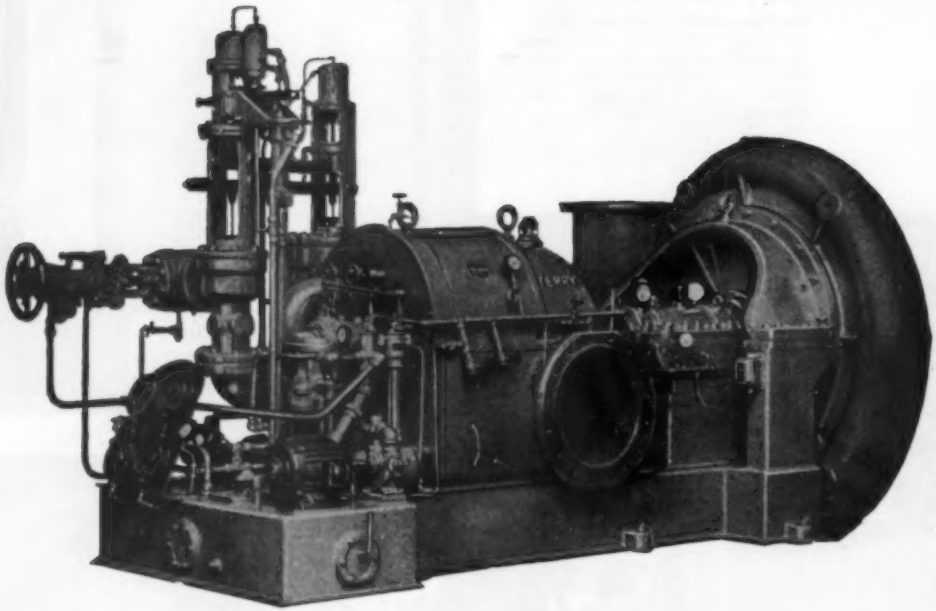
For detailed information, write for Specification No. 769.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4498 Wayne Ave., Philadelphia 44, Pa.

MINNEAPOLIS **Honeywell**

Brown Instruments

The TERRY TURBINE



SPECIAL PURPOSE TURBINE

FOR OPERATION UNDER ALL THESE CONDITIONS:

1. Straight, high-pressure, condensing
2. Straight, low-pressure, condensing—putting to work excess low-pressure steam.
3. Mixed pressure—using the low-pressure steam available, with only enough high-pressure steam required to drive the compressor
4. Condensing bleeder operation—providing clean, low-pressure steam for heating or process work

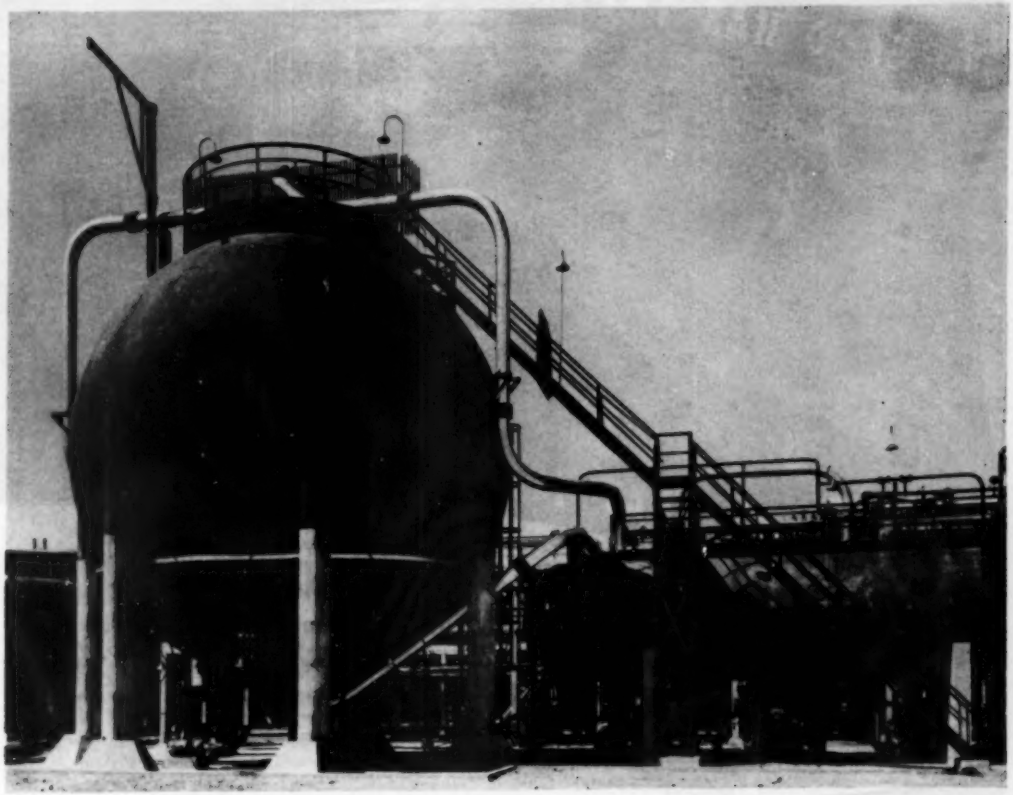
. . . and the speed under any of these conditions can be varied from 2800 to 4750 rpm.

This is but one example of many unusual combinations developed by Terry to meet out-of-the-ordinary requirements in turbines up to 2000 hp. Information on a special-purpose turbine for your specific requirements will be gladly furnished.

T1177

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

PAN AMERICAN *another leading refiner who desalts with PETRECO*



When the Pan American Refining Corporation made a thorough study of the effects of salts in the crude charge, their conclusions were that the charging of high-salt-content crudes resulted in low charging rates, short runs, excessive down-time, high repair costs, frequent equipment replacements and excessive strain, wear and tear on equipment. To prevent these difficulties a Petreco Electrosphere Desalter was installed.

The first run on desalted crude continued for over 2000 hours–before desalting, the time on stream had averaged around 700 hours! In addition, the crude charging rate was increased 33% and down time dropped from 73.3 to 39.0 days per year. The time for cleaning and repairing exchangers and furnaces was reduced approximately 50%. Because of these outstanding economies and operating benefits, Pan American installed another Petreco desalter to insure similar protection for another refining unit.

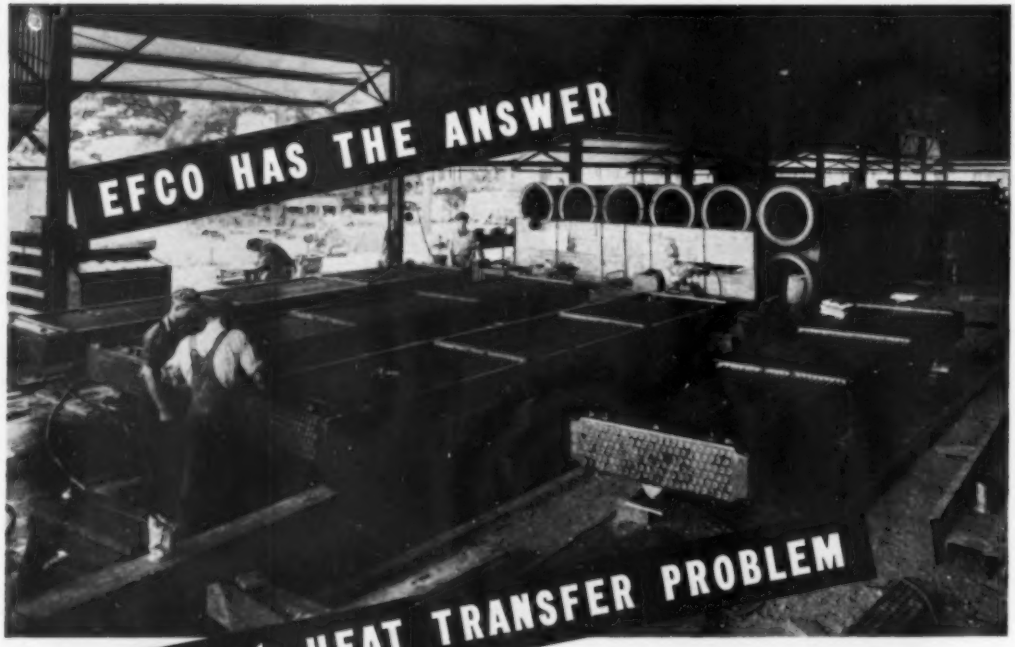
The Pan American Refining Corporation has proved that high-efficiency desalting is an asset to refinery operations. Like other leading refiners, Pan Am specifies Petreco Electrosphere Desalters to insure top desalting performance.

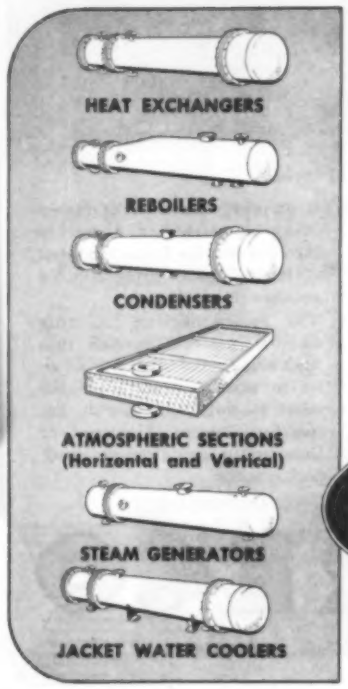
Petrolite Corporation, Ltd.
PETRECO DIVISION
3202 South Wayside Drive, Houston 3, Texas
1390 East Burnett Street, Long Beach 6, California

PETRECO

SPECIALIZED *Electric* PETROLEUM PROCESSES { DESALTING / DEHYDRATING

PR 51-7



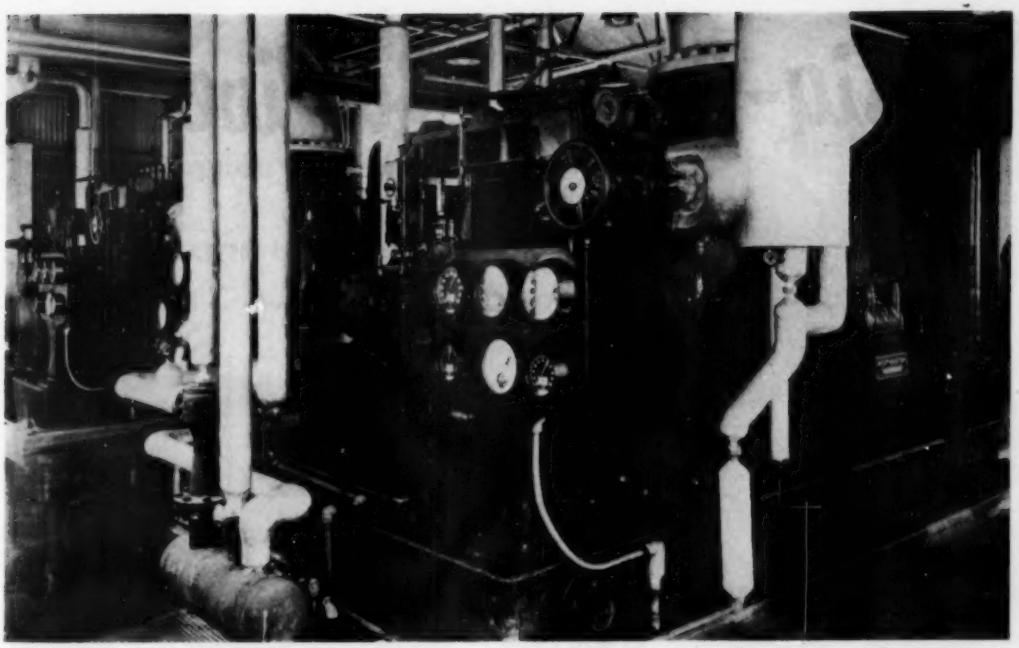


● If your problem is the poor performance or high maintenance cost of your heat transfer units, consult an EFCO engineer. He will help you decide the changes or modifications necessary to get the desired performance from your heat transfer equipment.

Backed by knowledge and experience, EFCO engineers are constantly working to produce heat transfer units that will give efficient performance and long, trouble-free operation.

ENGINEERS & FABRICATORS, INC.
P. O. Box 7395 Houston 8, Texas

EFCO
HEAT TRANSFER EQUIPMENT



Three Jobs for Steam—all powered by Worthington

They get a lot of work out of steam at Burnell-North Pettus Cycling plant near Pettus, Texas, operated by Stanolind Oil and Gas Company.

The Worthington turbine generator shown above is one of two providing electric power for general plant service. The steam turbines are 1,500 kw units, operating at 600 lb. gauge, 725 Ftt, and exhausting to 27 in. vacuum. The generators operate at three phase, 60 cycles, 70% power factor and are equipped with top-mounted air coolers.

There are also *nine* Worthington mechanical-drive turbines at this plant. Seven of these drive centrifugal pumps, and two drive induced-draft fans.

So – three jobs in all: electricity, pumps, fans.

This reliance on Worthington steam turbines is duplicated throughout the petroleum industry. Whether you want turbine-generator sets up to 10,000 kw or mechanical-drive turbines, Worthington has the correct type and size, with the petroleum industry's stamp of approval. A broad line of power plant equipment, giving you *unit responsibility*, and our unmatched experience in power plant applications are further reasons for doing business with Worthington.

Get the *savings* that steam offers—get *more work* out of steam. *There's more worth in Worthington.* For bulletins, write Worthington Pump and Machinery Corporation, Steam Turbine Division, Wellsville, N.Y.

WORTHINGTON

STEAM TURBINES T.1.2

A GREAT TEAM IN STEAM

● It is easy to understand why it took more than a rigger's version of "Geronimo" to set this giant propane tank "paratrooper"—and five more like it—snug aboard the S.S. Paolina . . . its 70'10" length would cover a strip on a big-league diamond from pitcher's slab to the end of the catcher's box, 10 feet behind the plate. Its 103" I.D. would allow a pitcher's full stretch . . . a batter's full swing.

Big-league delivery is an old Sun Ship custom. For more than 30 years its great plant has been making equipment for petroleum refineries—small tanks, fractionating towers, stills, pressure vessels, cracking cases, reactors, kilns, condensers, and machinery for all types of oil cracking and treating systems . . . And Sun Ship riggers have seen to it that they arrive . . . anywhere in the world . . . by ship, rail or truck . . . as ready for service as a paratrooper.

Sun

SHIPBUILDING & DRY DOCK COMPANY

SINCE 1916

ON THE DELAWARE • CHESTER, PA.

25 BROADWAY • NEW YORK CITY

★ **For Direct Heating of Liquids and Vapors**

★ **Indirect Heating Systems Using Circulating Medium**

Struthers Wells

FIRED HEATERS

for the Process Industries

A complete line of direct fired heaters is available in standard sizes from 100,000 to 25,000,000 BTU per hour. These units are in wide use in services such as heating gasoline, oils or asphalts, superheating steam or gas, and for indirect heating systems. The heaters are shipped shop assembled except for the largest sizes.

Struthers Wells indirect heating systems, utilizing either a vapor or liquid heat transfer medium, such as Dowtherm, are giving economical and trouble free operation at temperatures to 750° F., or above this.

Equipment is ordinarily supplied with instruments and safety controls to give a complete installation. Large installations in service for many years testify to the correct design and quality of this equipment.

If your process requires temperatures above those of existing steam supply, if steam is not readily available, or if the process can be improved by higher temperatures, this economical and simple equipment will be of interest. We can also supply smaller equipment, electrically heated, as package units.

Write on your letterhead for our new Bulletin B-45, describing a complete line of equipment for high temperature process heating.

Struthers Wells

STRUTHERS WELLS CORPORATION

Warren, Pa.

PLANTS AT WARREN, PA. • TITUSVILLE, PA.

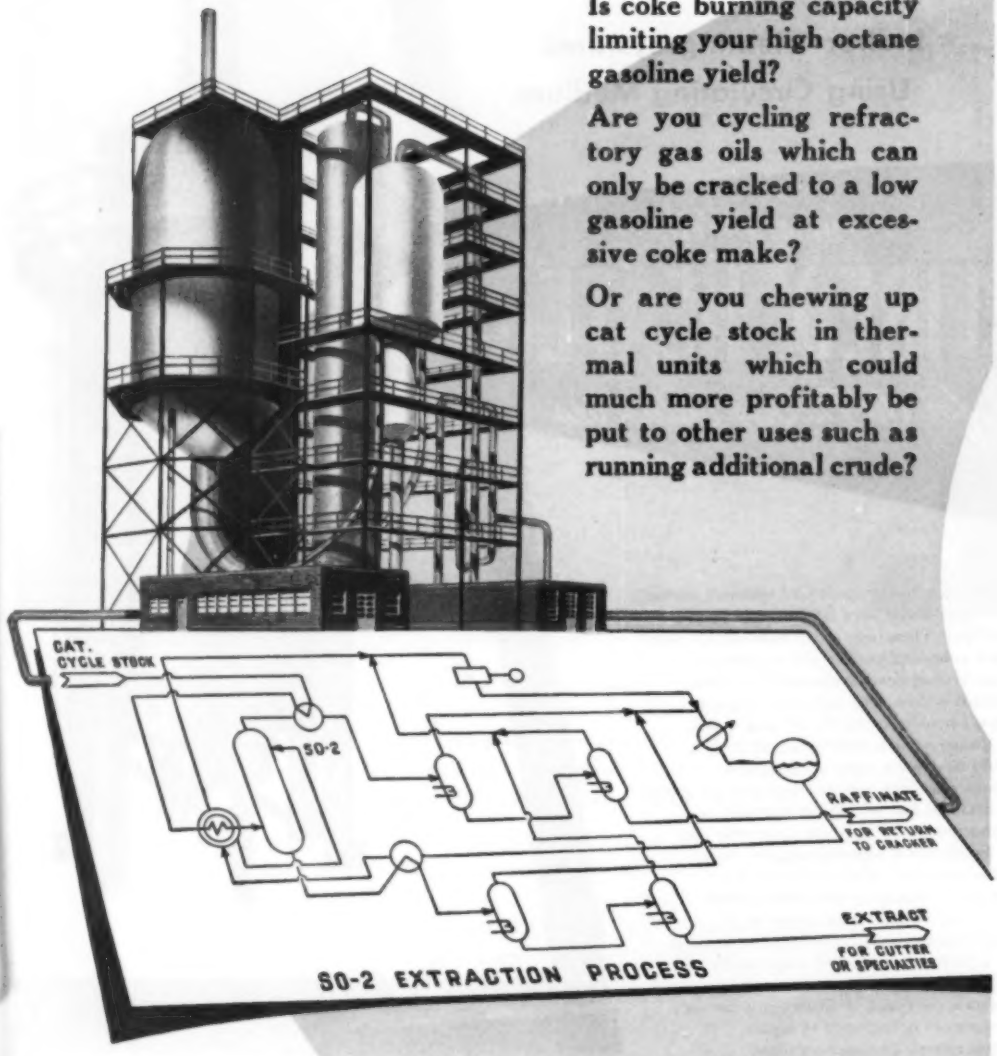
Offices in Principal Cities

"TEACH YOUR OLD

Is coke burning capacity limiting your high octane gasoline yield?

Are you cycling refractory gas oils which can only be cracked to a low gasoline yield at excessive coke make?

Or are you chewing up cat cycle stock in thermal units which could much more profitably be put to other uses such as running additional crude?



CAT NEW TRICKS"

INVESTIGATE SO_2 EXTRACTION OF CATALYTIC CYCLE STOCKS

This process will give high yields of raffinates which crack as well or better than virgin gas oil. The extraction operation removes sulfur and heavy aromatics, and the resulting raffinate will give a high gasoline yield, with frequently less coke than your fresh feed. This reduced coke make may permit recycling to extinction in your existing catalytic unit.

The extracts are highly aromatic, of low viscosity, and can be worked up into specialties or used for the viscosity cutting of heavy residuals. Depending upon your local utility balance, direct operating costs . . . utilities, labor, maintenance and solvent . . . may be less than 5c a barrel.

SO_2 extraction has been proved by many years of dependable operating experience. The solvent is cheap, universally available, and because of its low boiling point, product contamination and solvent recovery present no problems. Furthermore, an SO_2 plant is adaptable to running all types of stocks from light naphthas to heavy gas oils.

Let us give you more information about this versatile refinery tool.

BADGER PROCESS DIVISION
OF STONE & WEBSTER ENGINEERING CORPORATION

BOSTON NEW YORK
LONDON E. B. Badger & Sons (Great Britian) Ltd.

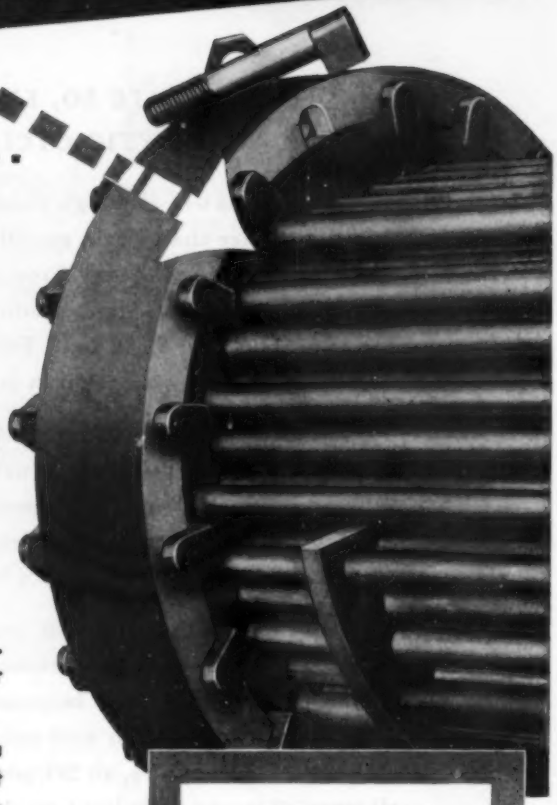
Process Engineers and Constructors for the Petroleum, Chemical and Petro-Chemical Industries

NO LEAKS HERE

with the patented . . .

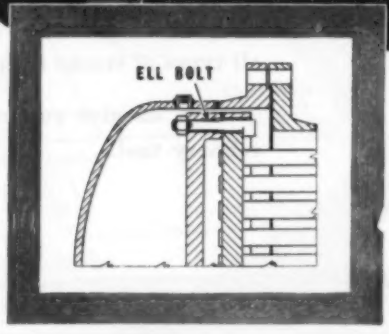
Vogt

ELL BOLT CONSTRUCTION of Floating Tube Sheet Assembly



YOU LOSE when an exchanger leaks . . . with the possibility of fluid contamination, or frequent shutdowns for repairs.

None of these evils need plague you when you employ the Vogt patented floating tube sheet assembly because there is no distortion of a split ring to worry about in making up the joint time after time. It's easy to make tight and it stays tight!



Bulletin HE-6 is a pictorial presentation of standard and special types of Vogt Heat Exchangers. Write for a copy on your letterhead.

Patent Nos.
1,895,735
2,232,478

HENRY VOGT MACHINE CO. INC. • LOUISVILLE 10, KY.

Branch Offices. New York, Philadelphia, Cleveland, Chicago, St Louis, Dallas

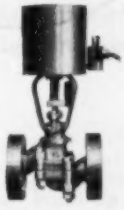
Vogt HEAT TRANSFER EQUIPMENT

IN *3 years...*

MODERN DESIGN AND USER ACCEPTANCE PUT 7500 ANNIN VALVES IN SERVICE

The thousands of ANNIN Valves in service today are a testimonial not only to their many design advantages but also to the phenomenal acceptance they have won in the field. Valve buyers and instrumentation engineers after putting their first ANNIN Valves to work "spread the word" that here were valves assuring positive control as well as versatility and ease of maintenance. Since 1948 when the first ANNIN Valve was made, many new features and models are being continually added to provide superior valves for the processing industry. Write today for new complete catalog of ANNIN Valves.

DOMOTOR



ELECTRO-PNEUMATIC

COMBINATION

HANDWHEEL

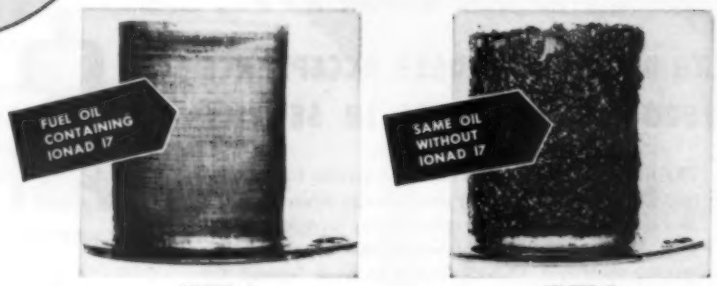
ANNIN VALVES

THE ANNIN COMPANY 3500 Union Pacific Avenue, Los Angeles 23, California

Now available to refiners...

IONAD 17

Field tested for 3 years in thousands of domestic installations



FILTER A FILTER B

What this filter screen test proves: Shown are 100-mesh screens from two full-scale tests run simultaneously. In each test 125 gallons of No. 2 fuel oil were circulated intermittently through a domestic fuel oil pump for 28 days. One test, containing Ionad 17, was circulated through Filter A. The other test, using the same oil, without Ionad 17, was circulated through Filter B. The two filter screens are a dramatic proof of the anti-clogging action of Ionad 17.

These results have been duplicated in thousands of domestic fuel oil burners. *Not a single case of failure due to a clogged screen was reported* in the three years Ionad 17 has been used.

IONAD 17

Shell's anti-clogging fuel oil additive IONAD 17

The essential ingredient that prevents clogging of filter screens

CLOGGING OF OIL BURNER and diesel filter screens, a major cause of equipment failure, now can be a thing of the past. Ionad 17, an oil soluble concentrate, when added to oil stocks, eliminates clogging of filter screens resulting from the agglomeration of tars and resin-forming compounds.

How Ionad 17 saves money

Ionad 17 is readily soluble in the various grades of domestic fuel and diesel oils. It reduces the incompatibility of fuel oil stocks, and minimizes further treatment. It has been found that in many refineries the cost of Ionad 17 is more than offset by savings in treatment.

The addition of Ionad 17 to bulk stores prevents the formation and build-up of deposits which form on tank bottoms. You save money in the reduced frequency of storage tank cleanings.

All of these advantages are now available to refiners. Technical information on Ionad 17 may be obtained from the nearest Shell Chemical office.

SHELL CHEMICAL CORPORATION

CHEMICAL PARTNER OF INDUSTRY AND AGRICULTURE

EASTERN DIVISION: 500 Fifth Avenue, New York 18
WESTERN DIVISION: 100 Bush Street, San Francisco 6

Los Angeles • Houston • St. Louis • Chicago • Cleveland • Boston • Detroit • Newark

YES INDEED, refinery men *everywhere* know how good Lagonda 1100 Series Tube Cleaners are.

They know that the fully lubricated motor with ball thrust bearings at each end delivers smashing power to the cutter head with practically no friction loss, giving faster, more thorough tube cleaning—saving costly minutes and hours in getting stills back on stream.

They know the Lagonda is no 'rookie' at cracking tough tube cleaning jobs—for over fifty years it has been a 'veteran' in the never-ending battle against coke of all types.

Ask your friends in the industry about Lagonda, and for 'fact and figure' details write for Bulletin 29.

IF IT'S TUBE CLEANING IT'S Lagonda

HALF CENTURY OF 1901 LC 1951 POWER PROGRESS

Better still (no pun intended) if you want quick action call for a representative. No obligation, of course.

Y-301

ELLIOTT Company

LAGONDA DIVISION • SPRINGFIELD, OHIO

Plants at: JEANNETTE, PA. RIDGWAY, PA. • AMPERE, N. J. SPRINGFIELD, O. • NEWARK, N. J. DISTRICT OFFICES IN PRINCIPAL CITIES

New look for old bearings

Santolube 394-C and Santolube 395-X are Monsanto's corrosion inhibitors and anti-oxidants which, added to suitable base stocks, produce motor oils that protect hard alloy bearings and keep them looking like new.

These additives improve lubricant stability and engine performance by minimizing lubricant oxidation, acid formation and sludge and varnish deposits, and by inhibiting bearing corrosion and lubricant thickening.

SANTOLUBE 394-C, with suitable base oils, may be used alone to compound premium-type lubricants, or it may be combined with detergent-dispersant additives, such as Santolubes 203-A, 303-A and 520, in proper oils, to get "Premium," "Medium Duty" and "Heavy Duty" lubricants.

SANTOLUBE 395-X was designed primarily for compounding "Premium" motor oils. It also may be used in combination with detergent-dispersant additives to make "Medium Duty" and "Heavy Duty" oils.

Both additives can be blended by using conventional equipment and methods. For further information, write MONSANTO CHEMICAL COMPANY, Organic Chemicals Division, 1775-J South Second Street, St. Louis 4, Missouri.

SANTOLUBE 394-C
(Typical Inspection Values)

Specific Gravity at 60°/60° F.	1.02
Viscosity S.U.S. at 210° F.	90
S.U.S. at 100° F.	2850
Flash Point °F.	200
Color ASTM (diluted)	3
% Phosphorus	4.7
% Sulfur	13.0

SANTOLUBE 395-X
(Typical Inspection Values)

Specific Gravity at 60°/60° F.	1.01
Viscosity S.U.S. at 210° F.	85
S.U.S. at 100° F.	1675
Flash Point °F.	230
Color ASTM (diluted)	5
% Phosphorus	3.8
% Sulfur	10.7
% Barium	1.0

MONSANTO PETROLEUM ADDITIVES

Pour-point depressants
SANTOPOUR®
SANTOPOUR B

Motor-oil inhibitors
SANTOLUBE® 395-X, 394-C

Viscosity-index improver
SANTODEX®

Gear-lubricant additive to meet requirements of Federal specification VV-L-761
SANTOPOID® 5

Gear-lubricant additives to meet requirements of military specification MIL-L-2105
SANTOPOID 29, 32, 33

Motor-oil detergents
SANTOLUBE 203-A, 303-A, 520

Corrosion inhibitor for distillate fuels
SANTOLENE® C

Sludge inhibitor for domestic fuel oils
SANTOLENE E

Cutting-oil additive
SANTOLUBE 52

Inhibitor-detergent combinations for premium and heavy-duty service
SANTOLUBE 205, 206, 360, 374, 379, 388, 521, 522

URGENT—Please round up tank cars, carboys and returnable drums and send them back to your chemical supplier. Containers are extremely short.

*Reg. U. S. Pat. Off.

MONSANTO
CHEMICALS — PLASTICS

SERVING INDUSTRY . . . WHICH SERVES MANKIND

NOW 3 GREAT PIPE INSULATIONS

Amocel

joins Unibestos in the UNARCO line of asbestos pipe insulations

...up to 650°F.

Answering the demand for a jacketed pipe insulation for use in the lower heat ranges, UNARCO now offers Amocel — for temperatures up to 650°F. Like Unibestos, Amocel is made of Amosite asbestos fibers bonded with an inorganic binder. For pipe sizes from ½" through 12", in Standard thickness only. Light in weight. Highly efficient. Durable.

UNIBESTOS
...up to 750°F.
UNIBESTOS
...up to 1200°F.

2 GREAT PIPE INSULATIONS — Unibestos No. 750 and No. 1200 — long have been America's outstanding insulations in their respective temperature ranges. Regular production for pipe sizes from ½" through 24" in popular thicknesses through 4". Other thicknesses and sizes available on order.

We want you to have our Catalog — It gives you complete information on Amocel and Unibestos Pipe Insulations; Unibestos Insulating Block; Cements and Finishes; Flexible Insulations; Metal Mesh Blankets; Tailored-to-Fit Insulations; Asbestos Packings and Gaskets; Asbestos Textile Products . . . Just drop us a line today requesting that we send you UNARCO Catalog No. 76-109.

UNARCO

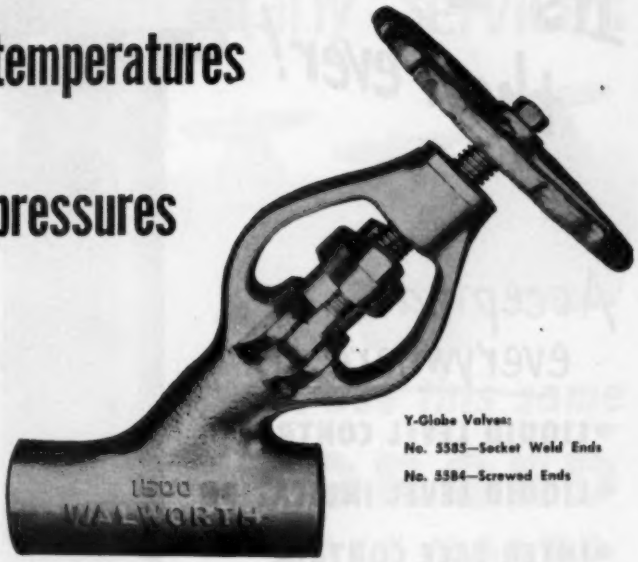
UNION ASBESTOS & RUBBER COMPANY

DEPT. 1823 • 332 SOUTH MICHIGAN AVENUE • CHICAGO 4, ILLINOIS

Walworth's NEW small cast steel valves

SERIES 1500 – SIZES ¼ to 2 inches

handle { HIGH / HIGH } temperatures / pressures



Y-Globe Valves:
No. 5585—Socket Weld Ends
No. 5584—Screwed Ends

Walworth is proud to make these new Small Cast Steel Valves available to power stations . . . oil refineries . . . ships . . . wherever piping is subject to severe pressures and temperatures. Non-shock service ratings of these valves: 1500 psi–950F for steam; 3600 psi–100F for water, oil or gas. Cast of chromium molybdenum steel, they are compact and light, yet exceptionally strong. Both Y-Globe and Angle type valves are available.

Angle Valves:
No. 5587—Socket Weld End
No. 5586—Screwed End

Simplified Walworth design eliminates many of the valve problems encountered in high pressure service. Among the features of this new valve are:

INTEGRAL BODY AND YOKE – made from a single casting without threading or welding. Bonnet joint — always a potential source of leakage — is eliminated. Valves can be reassembled quickly and easily.

ROTATING DISC – prevents valve seat distortion and consequent leakage. Cuts down replacements.

WELDED SEAT RING – compensates for changes in pressure and temperature—eliminates a major source of leakage.

SPECIAL BACK SEAT BUSHING – permits repacking the valve under pressure with greater safety.

PACKING CHAMBER – designed to dissipate heat thus keeping packing rings at lower temperatures—gives them longer life.

These valves are available with either socket weld ends or screwed ends, in sizes ranging from ¼ to 2 inches. For further information on Walworth series 1500 Small Cast Steel Valves, see your local Walworth distributor, or write for Circular No. 134.

WALWORTH

valves • fittings • pipe wrenches

60 EAST 42nd STREET, NEW YORK 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

It's Better than ever!

Improved Design

TYPE 2500-259
with fabricated steel float cage...

and the little Brother and Sister

TYPE 2500-249V
for side vessel mounting

TYPE 2500-249P
for top vessel mounting

Accepted everywhere for

- **LIQUID LEVEL CONTROL**
- **LIQUID LEVEL INDICATION**
- **INTER FACE CONTROL**

Yes – it's preferred, because it gives peak performance. The newly designed Fisher Series 2500 Level-Trol combines many improved features to better meet every field service requirement – to provide longer life with ease of maintenance. Write today for Fisher Bulletin F-3.

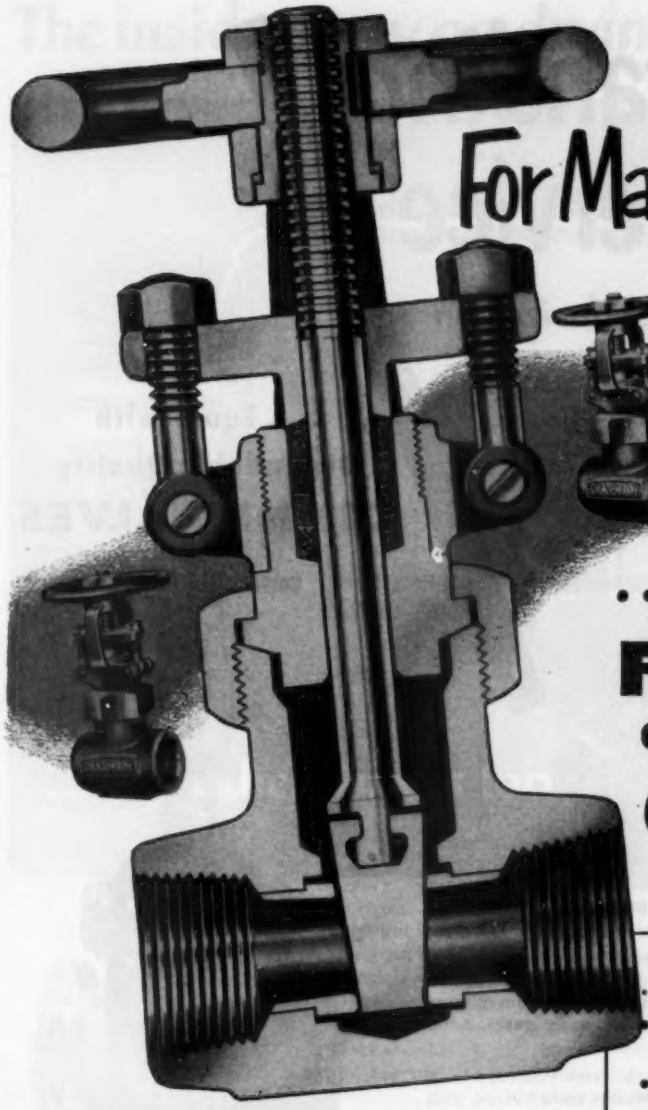
FISHER®

LEVEL-TROL®

FISHER GOVERNOR COMPANY
Marshalltown, Iowa

FISHER®

WORLD LEADER IN THE MANUFACTURE OF LIQUID LEVEL CONTROLLERS, PRESSURE REGULATORS AND IN RESEARCH FOR BETTER CONTROL



For Many Services

... Use this same

FORGED GATE VALVE

CHAPMAN LIST 960

... In these different alloys

- Carbon steel forgings with stainless steel (12-14 chrome) trim.
- Stainless steel (12-14 chrome) forgings with stainless steel (12-14 chrome) trim.
- Stainless steel (18-8) forgings and stainless steel (18-8) trim.
- Alloy steel (4-6) chrome body forgings with stainless steel (18-8) or Cyclops trim.

To all the many jobs for which it's qualified, Chapman List 960 brings *extra* wear-resistance in exclusive features like these:

Extra strength of stem-and-wedge gate connection provides protection against even unusual service stress.

Super-hardened seat rings and wedge-faces of stainless steel.

Bolted Follower with no follower threads on yoke to corrode. Follower easily tightened down any time when necessary.

List 960 comes in sizes from ¼" to 2". Joints either gasketed or metal-to-metal. Two types: Rising stem with yoke (shown), or rising stem with inside screw. Pressure range: 2000 lb. at 100°F.—380 lb. at 1000°F. (For higher pressures, specify List 990.) Send for illustrated bulletin on List 960.

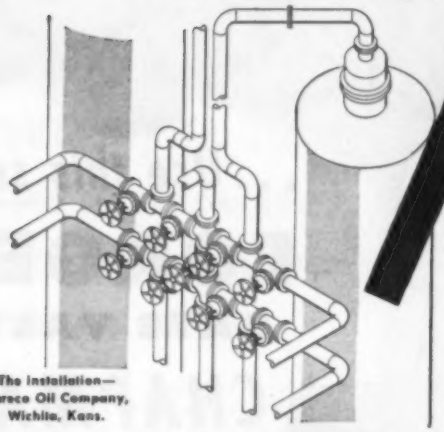
The CHAPMAN Valve Manufacturing Company

INDIAN ORCHARD, MASSACHUSETTS

for outstanding service

on Gasoline Desulfurization

...for example



The installation—
Barsco Oil Company,
Wichita, Kans.

PROBLEM: To select valves that would stay absolutely tight on hot gasoline, steam-air mixture, and catalyst regeneration waste gases, for control manifold to reaction chambers on Perco Cycloversion unit.

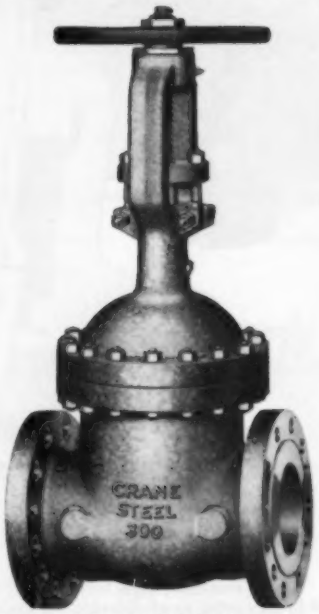
WORKING CONDITIONS: Cyclic operation; approximately 15-day cycles. At oil inlet, straightrun gasoline handled at 950 Deg. F., 85 psi. For catalyst regeneration, air-steam mixture at 850 Deg. F., 15 psi. Regeneration waste gases, 1200 Deg. F., 5 psi.

SOLUTION TO PROBLEM: Crane 8-inch, 300-Pound, No. 5 Chrome-Molybdenum Alloy Steel Wedge Gate Valves, with Stellite seats and patented flexible disc design.

RESULTS: After more than 2 years' service, all Crane valves are absolutely tight and operating at highest efficiency, with no maintenance.

ANOTHER TYPICAL CASE HISTORY, demonstrating the low ultimate cost of Crane Valves of every type. And the reason why...
More Crane Valves are used than any other make!

...Equip with Dependable Quality CRANE VALVES



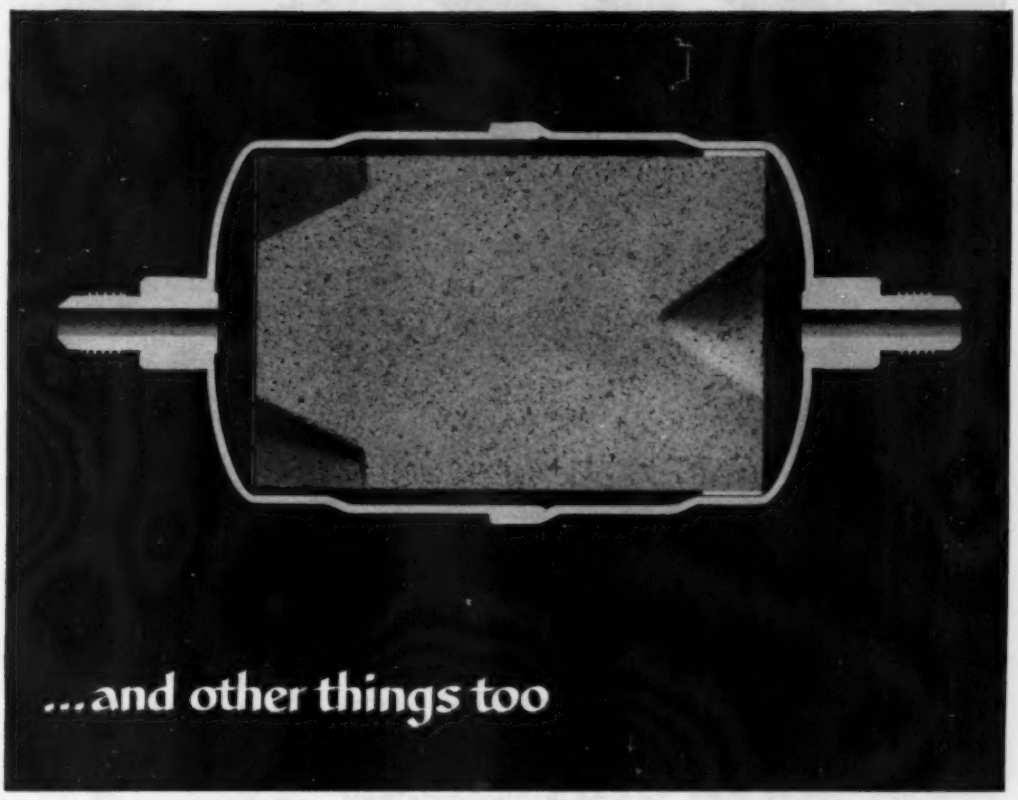
300-Pound Cast Steel Wedge Gate Valve. In body and trim materials for all refinery services. See your Crane Catalog.

CRANE CO.

General Offices:
836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

The inside story on drying refrigerants



Continually maintaining a *dry* refrigerant is essential to the operation of any refrigeration system. But *how much* moisture is removed is far less important than *how little* is left—even a drop of water can cause expensive breakdowns. An exceptionally efficient drying agent—such as ALCOA *Activated* Alumina—is required for such an exacting job.

That's why Sporlan Valve Company, St. Louis, Mo., put ALCOA *Activated* Alumina inside their Catch-All Filter-Drier, illustrated above. Molded of granulated alumina, the unique porous core dries refrigerants to an end point so low that any remaining moisture is harmless. Moreover, it cannot channel or powder because ALCOA *Activated* Alumina is a thoroughly reliable, non-corrosive drying agent that will not change its form or properties—will not swell, soften or disintegrate.

Helping to keep refrigerators cold is only one of many jobs ALCOA *Activated* Alumina is doing successfully. Its desiccating properties are finding widespread application in the chemical, food, pharmaceutical and petroleum industries, in air conditioning, and for the maintenance of transformer and lubricating oils.

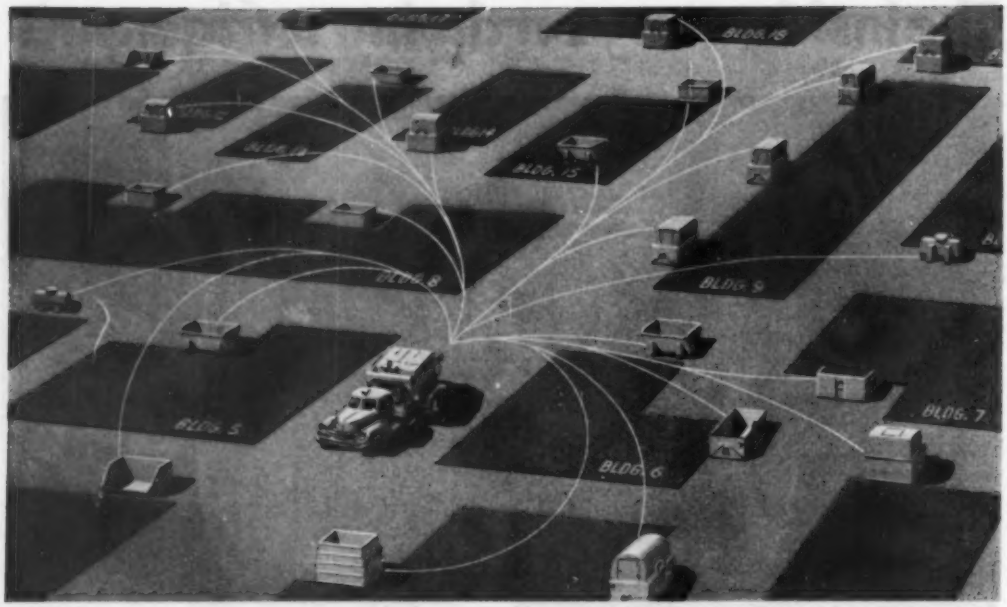
You should be taking advantage of the economies offered by ALCOA *Activated* Alumina. We'll gladly send you additional information. Write to: ALUMINUM COMPANY OF AMERICA, CHEMICALS DIVISION, 617K Gulf Building, Pittsburgh 19, Pa.

Alcoa Chemicals

ALCOA

ALUMINAS and FLUORIDES

ACTIVATED ALUMINAS • CALCINED ALUMINAS • HYDRATED ALUMINAS • TABULAR ALUMINAS • LOW SODA ALUMINAS ALUMINUM FLUORIDE • SODIUM FLUORIDE • SODIUM ACID FLUORIDE • FLUOBORIC ACID • CRYOLITE • GALLIUM



★ Never Before Have You Been Able To Cut Bulk Materials Handling Costs So Drastically

Pictured above is a skeleton layout of a typical industrial plant using the Dempster-Dumpster System — one truck mounted Dempster-Dumpster handles the entire group of 26 Dempster-Dumpster containers of six different types. These big, detachable steel containers are like having 26 truck bodies for a single truck.

Any required number of Dempster-Dumpster containers are spotted at convenient materials accumulation points inside and outside your plant. They range in sizes up to 10 cu. yds. and are made in various designs to suit your particular needs. Materials — bulky, light, heavy, solids, rubbish and even liquids—are dumped or placed in these containers. The truck mounted Dempster-Dumpster makes scheduled rounds, picks up each preloaded container, carries it to the point of disposal, sets it down intact or dumps the materials and returns the container for refilling. The entire operation is hydraulically controlled and handled by only one man, the driver.

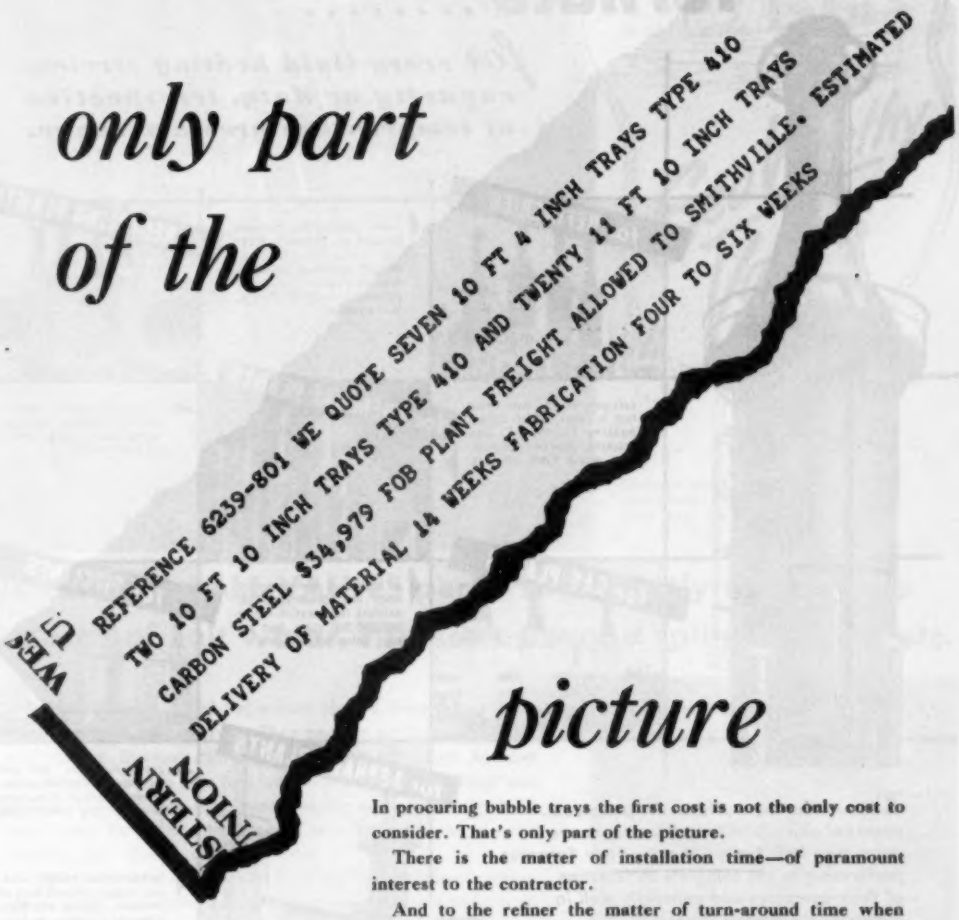
It is not unusual for one Dempster-Dumpster to eliminate up to 10 conventional trucks . . . reducing investment accordingly. This means cutting maintenance costs, tire and gas requirements tremendously. And, more important, it increases production with a minimum of manpower. It will pay you to investigate the Dempster-Dumpster System now! A product of Dempster Brothers, Inc.

Above, the Dempster-Dumpster is shown in the three simple stages of picking-up, hauling and dumping an 8 cu. yd. drop bottom container . . . completing the cycle in one to two minutes. These photos show the ease with which the Dempster-Dumpster handles all containers, regardless of their type, size or whether they are bottom or tilt dumping types.

The important feature to remember is that only one truck-mounted Dempster-Dumpster and driver handles one container after another in an endless cycle, constantly on the move for economy and efficiency never before available in bulk materials handling.

DEMPSTER BROTHERS, 5101 Dempster Bldg., Knoxville 17, Tennessee

only part of the picture


WESTERN UNION
REFERENCE 6239-801 WE QUOTE SEVEN 10 FT 4 INCH TRAYS TYPE 410
TWO 10 FT 10 INCH TRAYS TYPE 410 AND TWENTY 11 FT 10 INCH TRAYS
CARBON STEEL $34,979 FOB PLANT FREIGHT ALLOWED TO SMITHVILLE. ESTIMATED
DELIVERY OF MATERIAL 14 WEEKS FABRICATION FOUR TO SIX WEEKS

In procuring bubble trays the first cost is not the only cost to consider. That's only part of the picture.

There is the matter of installation time—of paramount interest to the contractor.

And to the refiner the matter of turn-around time when replacements become necessary is of even greater importance.

Exclusive design features of Gilbarco Bubble Trays and Caps that cut installation costs and turn-around time are today's outstanding advance in fractionating tower internals. Let us give you complete information.

GILBERT & BARKER
MANUFACTURING CO.
WEST SPRINGFIELD
MASSACHUSETTS

There's a PETRO-CHEM ISO-FLOW *furnace .....*

for every fluid heating service, capacity or duty, irrespective of temperature pressure range.

for REFINERIES

crude distillation, vacuum distillation, thermal cracking, catalytic cracking, thermal reforming, catalytic desulphurization, catalytic reforming, solvent refining, isomerization

for RECYCLING PLANTS

catalysis heaters with catalyst in tubes, steam superheating to 1500°F, gas cracking, reactant distillation, direct fired reboiling

for CHEMICAL PLANTS

rich oil distillation, secondary fractionation, depropanizing, debutinizing, reboiling heat medium

for GAS PLANTS

at individual leases and for main line dehydration for catalyst regeneration—up to 500,000,000 cubic feet per day, unlimited pressure

for PIPELINES

for ASPHALT PLANTS

gas dehydration, gas and air superheating for turbine drives, reduction of viscosity of oil in long transmission lines

including tank heating, loading heaters, manufacture of linoleum, roofing and tile—circulating heaters for saturates

Throughout the world, in the petroleum, chemical and allied industries, there are more than 800 Petro-Chem Iso-Flow Furnaces performing to the complete satisfaction of their operators and generally well in excess of their rated capacities.

PETRO-CHEM

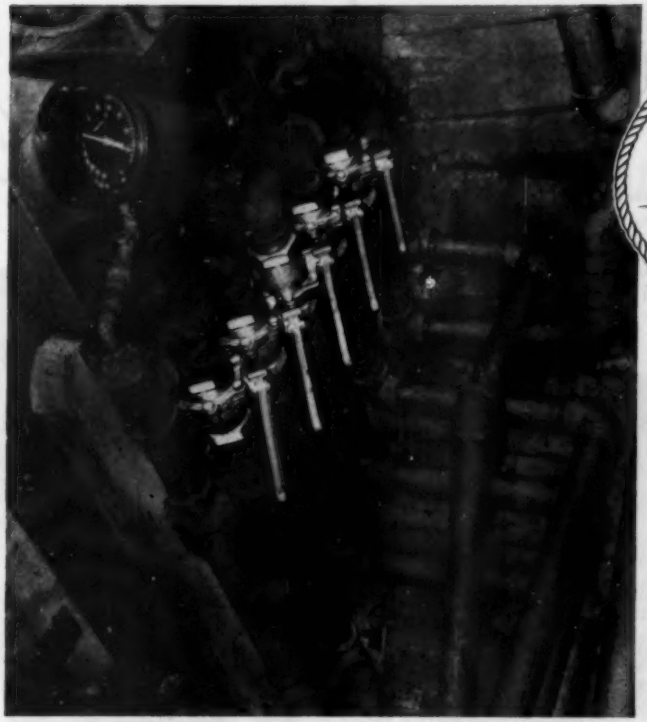
ISO-FLOW FURNACES

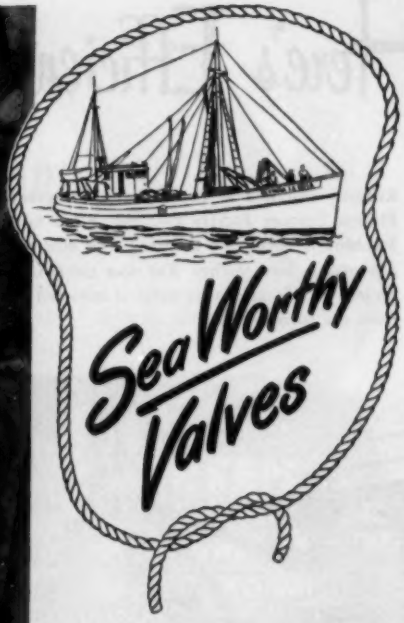
UNLIMITED IN SIZE . . . CAPACITY . . . DUTY

PETRO-CHEM DEVELOPMENT CO., INC., 120 EAST 41ST STREET, NEW YORK 17, N.Y.

REPRESENTATIVES

Bethlehem Supply, Tulsa and Houston · Flagg, Brackett & Durgin, Boston · D. D. Foster, Pittsburgh
Faville-Levally, Chicago · Lester Oberholz, California · Gordon D. Hardin, Louisville, Kentucky





Discharge Manifold used for quick change-over of discharge-water from two centrifugal pumps.

ROCKWOOD BALL VALVES perform perfectly against the hazards of salt water, fish scales, wood splinters, dirt, etc.

Every Rockwood Ball Valve used aboard these fishing boats has given *outstanding* service. They perform continuously without maintenance. Dirt and debris from bilges is no problem. Abrasive or corrosive mixtures pass thru valve without injury to rubber seat or ball. Quick change-over from pumping out boat to supplying wash water for deck is made easier and faster because of quick opening and closing action of valve.

Mr. C. Perkins, Engineer of Hub Machine Company, Boston, Mass., says "Rockwood Ball Valves *out-wear* and *out-perform* all other makes of valves used previously on these installations."

Thousands of Rockwood Ball Valves are at work thru-out the country speeding production, cutting maintenance cost, helping maintain high quality and making piping operations easier.

Rockwood Valves are available in bronze in pipe sizes from ½" to 2" and in cast steel from 3" to 4". They are recommended for 300 p. s. i. working pressure. Rockwood Valves are in service in oil refineries, food, paper, textiles, chemical and rubber plants.

Write for bulletin V4 — and for information regarding applications, prices, etc.

Distributors in all principal cities.

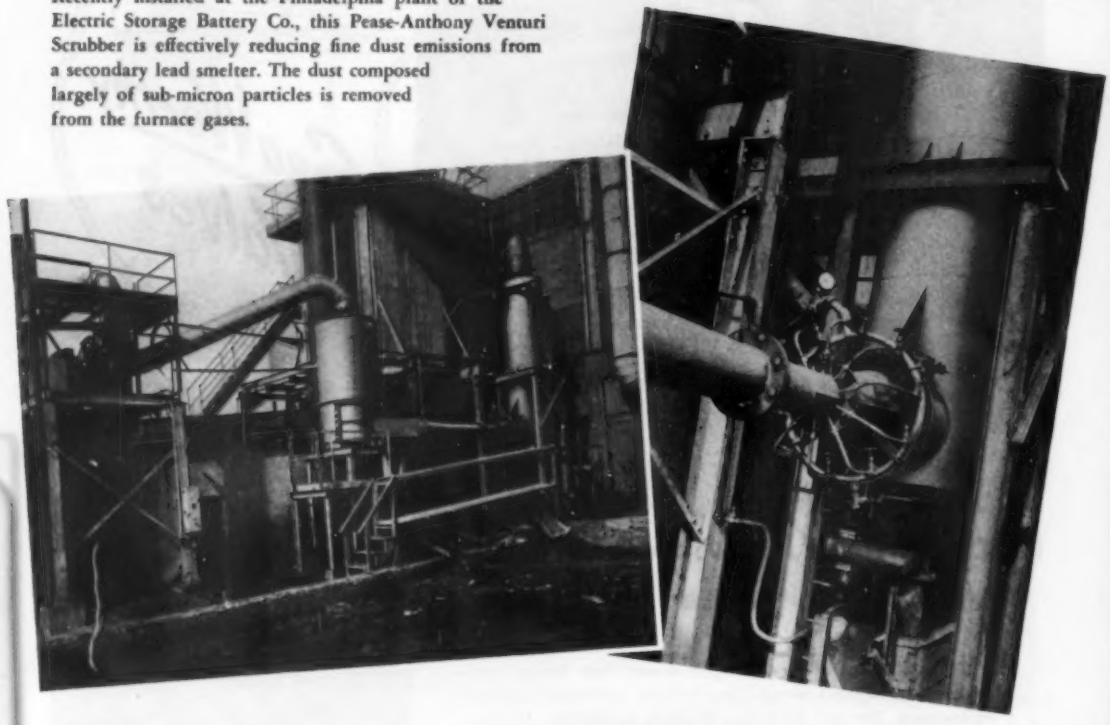
Bilge Manifold used for connecting various bilges to the pumps. Quick action is necessary because of limited time — also makes priming of centrifugal pumps easier.

ROCKWOOD

ROCKWOOD
SPRINKLER COMPANY
102 HARLOW STREET
WORCESTER 5, MASS.

Here's Efficient DUST and FUME Removal

Recently installed at the Philadelphia plant of the Electric Storage Battery Co., this Pease-Anthony Venturi Scrubber is effectively reducing fine dust emissions from a secondary lead smelter. The dust composed largely of sub-micron particles is removed from the furnace gases.



Other Typical Applications

Chemico P-A Venturi Scrubbers are now being used in a wide range of industries for the highly efficient removal of micron and sub-micron dusts and fumes. For a detailed analysis of your scrubbing problem, write or call our P-A Sales Department.

APPLICATION	MATERIALS BEING REMOVED	DUST AND FUME LOADINGS Inlet to Scrubber	Outlet from Scrubber
DUSTS			
Diatomaceous Earth Plant	Diatomaceous Earth	1.2 grains/scf	0.05 grains/scf
Rubber Blenders	Carbon Black	0.3 grains/scf	0.003 grains/scf
Yellow Brass Foundry Furnace	Zinc Oxide	3.5-10 grains/scf	0.7 grains/scf
Lime Kilns	Lime and Na_2O Fumes	7.0 grains/scf	0.02 grains/scf
Electric Furnace Fumes	Iron Oxide	0.2 grains/scf	0.03 grains/scf
Blast Furnace	Iron Oxide	4.0-20.0 grains/scf	0.008-0.08 grains/scf
Secondary Lead Blast Furnace	Lead and Rubber Compounds	1-10 grains/scf	0.05-0.20 grains/scf
FUMES			
Copperas Roasting Plant	H_2SO_4 Mist	100-300 Mg/scf	1-5 Mg/scf
Titanium Plant	H_2SO_4 Mist	120 Mg/scf	2.0 Mg/scf
Phosphoric Acid Plant	H_3PO_4 Mist	100-300 Mg/scf	3.0 Mg/scf
Wood Distillation	Tar Fog and Acetic Acid Mist	1000 Mg/scf	10-40 Mg/scf
Enamel Smelting Furnace	Dust and Fluoride Fumes	55.0 Mg/scf	4.0 Mg/scf
Dry Ice Plant	Amine Fog	25.0 Mg/scf	5.0 Mg/scf

CHEMICAL CONSTRUCTION CORPORATION

A UNIT OF AMERICAN CYANAMID COMPANY

488 MADISON AVENUE, NEW YORK 22, N. Y.

CABLES: CHEMICONST, NEW YORK

EUROPEAN TECHNICAL REPRESENTATIVE

CYANAMID PRODUCTS, LTD., NORTH WEST WING, BUSH HOUSE

ALDWYCH, LONDON W.C. 2, ENGLAND

CC-224

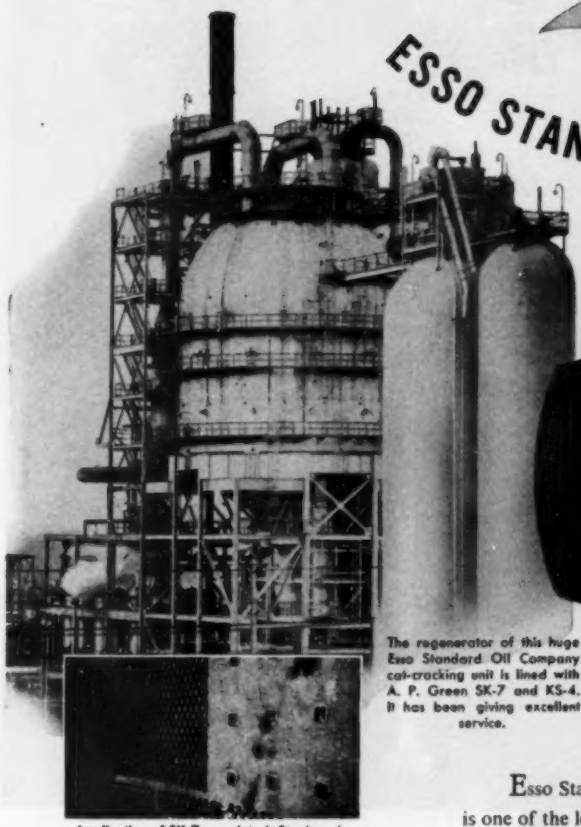
Chemico plants are profitable investments

ESSO STANDARD OIL COMPANY

Uses

A. P. GREEN SK-7 KS-4

for Regenerator Lining



The regenerator of this huge Esso Standard Oil Company cat-cracking unit is lined with A. P. Green SK-7 and KS-4. It has been giving excellent service.

Application of SK-7 completed. Steel mesh attached to studs preparatory to shooting KAST-SET KS-4.

Interior of Catalytic Regenerator showing the completed lining with the KAST-SET KS-4 applied over the CASTABLE No. 20 SK-7.

CHECK THESE ADVANTAGES OF SK-7 and KS-4

1. Cuts installation time and labor costs
2. Construction costs held to minimum
3. Rebound loss reduced
4. Adaptable to a variety of installations
5. Results in linings with balanced characteristics of poured castables

Esso Standard Oil Company, Linden, New Jersey, is one of the leaders in the petroleum industry who use A. P. Green SK-7 and KS-4 for lining regenerators in cat-cracking units. The contour of cat-cracker regenerators lends itself to the use of these specially designed and engineered gun-applicable refractory castables.

CASTABLE No. 20 SK-7 is a lightweight insulating castable recommended for a service temperature of 1800° F. KAST-SET KS-4 is a castable refractory with a top service temperature of 2750° F. Both were designed specifically for gun application in the Petro-Chemical industry.

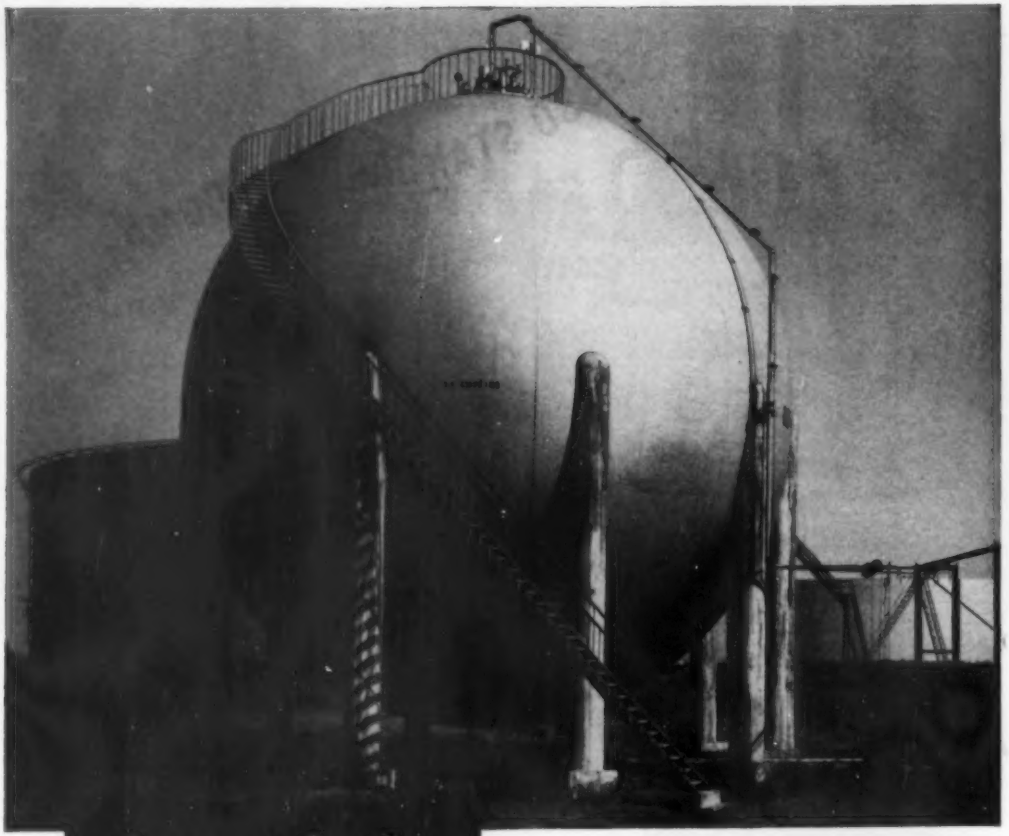
For detailed information concerning these castable refractories, write the Engineering Department of the A. P. Green Fire Brick Company — or call your local A. P. Green Distributor.

A. P. Green REFRACTORY PRODUCTS

A. P. GREEN FIRE BRICK COMPANY
Mexico, Missouri, U. S. A.

In Canada
A. P. GREEN FIRE BRICK COMPANY, LTD.
Toronto 15, Ontari

DISTRIBUTORS IN THE PRINCIPAL CITIES OF THE WORLD



Cutting the Cost OF VOLATILE LIQUID STORAGE

IN storing butane or similar hydrocarbons, the Hortonsphere proves its operating efficiency by giving more dependable service at a minimum cost. Here is better storage that can put greater profits into your operation.

One important saving is steel. With today's critical material shortages—the Hortonsphere requires less steel per barrel of capacity than a container of any other shape.

Also the Hortonsphere reduces maintenance by permitting easy accessibility to the entire tank shell. Painting is both quicker and simplified because of the reduced surface area.

Finally, the Hortonsphere gives more years of service because interior corrosion is minimized. That's due to the absence of oxygen inside the tank.

Hortonspheres are built in standard capacities ranging from 1,000 to 25,000 bbls. Information on these pressure containers or other efficient Horton storage units may be obtained by writing our nearest office. Take advantage of this service. There is no obligation on your part.

CHICAGO BRIDGE & IRON COMPANY

Plants in **BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNSYLVANIA**

Atlanta 3	2146 Healey Building	Detroit 26	1520 Lafayette Building	Salt Lake City 4	531 West 17th South Street
Birmingham 1	1548 North Fiftieth Street	Houston 2	2126 National Standard Building	San Francisco 4	1551—200 Bush Street
Boston 10	1030—201 Devonshire Street	Los Angeles 17	1534 General Petroleum Building	Seattle 1	1331 Henry Building
Chicago 4	2463 McCormick Building	New York 6	3302—165 Broadway Building	Tulsa 3	1627 [illegible] Building
Cleveland 15	2234 Guildhall Building	Philadelphia 3	1608—1700 Walnut Street Building	Washington 6, D. C.	1128 Cafritz Building

REPRESENTATIVES AND LICENSEES

Ateliers et Chantiers de la Seine Maritime, Paris, France
Compagnia Tecnia Industria Petroli, Rome, Italy
Constructions Metalliques de Provence, Arles-sur-Rhone, France
Chicago Bridge & Iron Company, Ltd., Apartado 1348, Caracas, Venezuela
Horton Steel Works, Limited, Fort Erie, Ontario, Canada
Motherwell Bridge & Engineering Company, Limited, Motherwell, Scotland
Whessoe, Limited, Darlington, England
Comprimo N. V., Amsterdam—O, Netherlands
Sociedade Chibridge de Construcoes Ltda., Av. Franklin Roosevelt, 194-S/704-C, Rio de Janeiro, Brazil

BUILDING OR MAINTAINING INSTALLATIONS...

Here's THE BEST SUPPLY COMBINATION FOR YOU TO USE!

Top service—top quality!

In the natural gasoline and cycling industries, construction and maintenance engineers alike know that Continental's fast, efficient service . . . coupled with top-quality stocks . . . provide for your special as well as your routine requirements . . . help you avoid costly delays!

Ladish Co.
Walworth Co.
C. H. Dragert Company
Clayton Mark & Company
Fisher Governor Co. • The Lunkenheimer Co. • George D. Roper Corp. • Penberthy Injector Co. D. W. Onan & Sons., Inc. • Farrar & Trefts, Inc. • Grinnell Co., Inc. • Gardner-Denver Co. Nordstrom Valve Division • Socony Paint Products Co. Larkin Packer Co., Inc. • Construction Machinery Co. Broderick & Bascom Rope Co. • Dayton Rubber Co. • Henry Vogt Machine Co., Inc. • Crosby Steam Gage & Valve Co. • New York Belting & Packing Co. • Stockham Valves & Fittings • W. C. Norris Mfg., Inc. • The Youngstown Sheet and Tube Co. • Marsh Instrument Co.

ASSOCIATED MANUFACTURERS

Call or visit your Continental store or office—today!

CONTINENTAL

SERVING THE OIL AND GAS INDUSTRIES

THE CONTINENTAL SUPPLY COMPANY, *General Offices:* DALLAS, TEXAS

Export Division: The Continental Supply Co., Inc., 30 Rockefeller Plaza, New York, N. Y.
The Continental Supply Company, Limited, 216 Lancaster Building, Calgary, Alberta

Representatives: ARGENTINA • BOLIVIA • BRAZIL • CHILE • COLOMBIA • ENGLAND • ECUADOR • PERU • TRINIDAD • URUGUAY • VENEZUELA

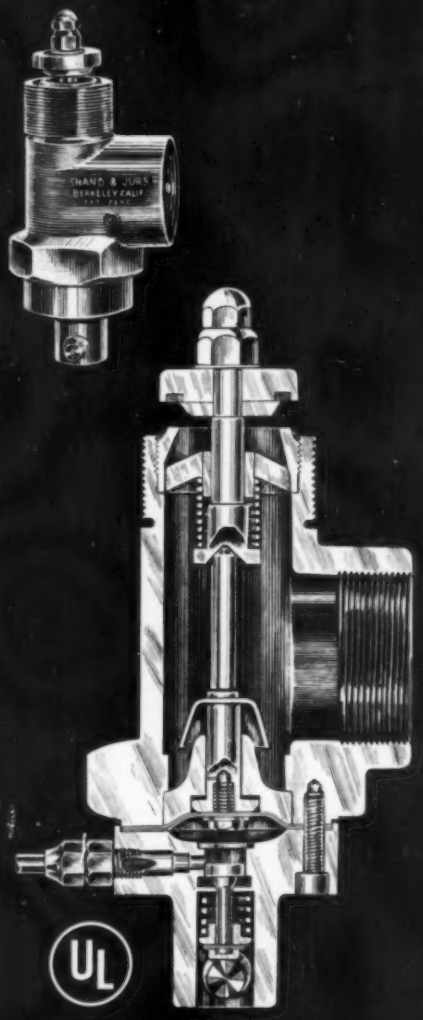
S&J

Announces New

SAFETY VALVE FOR LP-GAS TRUCK TANKS

"SAFETIFLO" the new, revolutionary Internal Safety Valve for LP-Gas truck tanks provides even greater safety in the delivery of LP-Gas than the commonly used excess flow check and shut-off valves, which it is designed to replace. Should an accident tear away or rupture the delivery line or hose, the "Safetiflo" automatically closes . . . and stays closed under constant spring force and internal tank pressure. "Safetiflo" is the SAFE Internal Valve for LP-Gas delivery trucks, as attested by its listing by Underwriters' Laboratories, Inc.

Developed jointly by Phillips Petroleum Company and S&J, "Safetiflo," S&J Fig. 13980, has had over five years extensive field testing. The cast steel body is provided with a weakness groove, and with the two-piece operating stem, permits complete or partial break-off of the valve at the tank outlet without impairing valve closure or reducing safety. If you want to make your LP-Gas deliveries faster and safer, contact the nearest branch office listed below or the S&J factory for additional information on the new "Safetiflo" LP-Gas valve.



UL

Shand and Jurs Co. 8TH AND CARLTON STREETS : BERKELEY : CALIFORNIA

NEW YORK 295 Madison Ave. | CHICAGO 10609 S. Western Ave. | HOUSTON 827 M & M Bldg. | TULSA 310 Thompson Bldg. | LOS ANGELES 714 W. Olympic Blvd. | SEATTLE 3000 Western Ave.

MONTREAL, QUE., 360 Notre Dame St. West | VANCOUVER, B. C., 550 Beatty St. | FORT ERIE, ONT. | DARLINGTON, ENG. | CARACAS, VEN.

Look to ENJAY

*Trade-Mark

for an extensive line of oxygenated solvents and chemicals

The famous ENJAY* Oval Trade-mark stands for a diverse line of high-quality chemicals and solvents. An increasing number of industries are using dependable Enjay chemicals to increase product quality.

EXPERIENCED RELIABLE DIVERSIFIED

ENJAY markets this wide range of industrial chemicals:

Petrohol 91 (Isopropyl Alcohol)
Petrohol 95 (Isopropyl Alcohol)
Petrohol 99 (Isopropyl Alcohol)
Secondary Butyl Alcohol
Isooctyl Alcohol
Isopropyl Acetate
Secondary Butyl Acetate
Acetone
Methyl Ethyl Ketone
Ethyl Ether
Isopropyl Ether
Diisobutylene
Polypropylenes
Butadiene
Isoprene
Dicyclopentadiene
Aromatic Tars
Paratone
Parapoid
Paratac
Paranox
Paraflow
Vistanex
Naphthenic Acids

Enjay products are marketed in drum and tank car quantities

ENJAY COMPANY, INC.
15 W. 51st St., New York 19, N.Y.

DOWELL SERVICE

CHEMISTRY APPLIED TO MAINTENANCE CLEANING PROBLEMS

This Refinery asked:

Can you clean catalytic cracker equipment?

Dowell Service cleaned slurry exchangers—through-put increased 6,000 barrels a day!

Through-put on a fluid catalytic cracker in a large refinery was reduced because deposits badly fouled the slurry exchangers. Dowell Service cleaned the shell side of these exchangers in less than 12 hours. As a result of the cleaning, the operator was able to step up the through-put on the cracking unit from 16,000 to 22,000 barrels per day. This increased efficiency also made it possible to postpone a proposed shut-down for a major overhaul of the unit.

On another catalytic cracker, the increased through-put resulting from Dowell Service had an estimated value of $4,300 per day.

All types of equipment on catalytic crackers have been cleaned effectively by Dowell Service methods . . . *without dismantling and with a minimum of down-time.* Dowell furnishes trained personnel and all necessary equipment. Dowell engineers apply liquid solvents according to the technique demanded by the job: for example, by filling, spraying, jetting, cascading or vaporizing. These solvents are designed to remove deposits quickly, efficiently and economically. Often equipment may be cleaned while it is in operation.

Call Dowell for assistance on your maintenance cleaning problems. Dowell Service is applicable to condensers, process towers, pipe lines, storage tanks, boilers, cooling jackets and other refinery equipment. Experienced Dowell engineers will be glad to consult with you. No obligation, of course. Phone the nearest Dowell office today.

Other recent Dowell jobs:

Dowell Service cleaned a steam driven turbine blower surface condenser. After cleaning, heating efficiency increased almost 200%. Higher vacuum permitted greater speed on blower.

•

Three waste heat boilers were Dowell cleaned. Following this fast, efficient service, these boilers produced 23% more steam per hour with an estimated $49 per day payout to refinery.

•

In just one day, Dowell Service thoroughly cleaned heavy ferrous ferrocyanide deposits from a bubble cap rectifier column. This column was restored to top operating efficiency.

DOWELL INCORPORATED • TULSA 1, OKLAHOMA

CALL

New York 20	Buffalo 2	Wichita 2	Hamilton, Ohio
Boston 16	Cleveland 13	Oklahoma City 2	Charleston, W. Va.
Philadelphia 2	Pittsburgh 19	Houston 2	Salem, Illinois
Baltimore	Detroit 2	New Orleans 12	Beaumont, Texas
Wilmington 99	Chicago 4	Ft. Worth 2	Borger, Texas
Richmond 19	St. Louis 8	Shreveport 69	Midland, Texas
Jacksonville 2	Louisville	Anniston, Alabama	Wichita Falls, Texas
Atlanta	Kansas City 8	Mt. Pleasant, Mich.	Lafayette, La.

Long Beach, Oakland, Casper: Dowell Associate—International Cementers, Inc.

★*Maintenance cleaning service for industrial heat exchange equipment.*
★*Chemical services for oil, gas and water wells.*
★*Magnesium anodes for corrosion control.*

DOWELL

A Service Subsidiary of
THE DOW CHEMICAL COMPANY

PETROLEUM REFINER

The LOOK BOX

Oil Progress Week

THE BIG EVENT of this month in the industry is Oil Progress Week, to be observed October 14-20. Started in 1947 by the observance of Oil Progress Day, this program of public enlightenment has grown beyond the most hopeful expectations.

This year, in virtually every community in the country, from coast to coast, Oil Progress Week will be observed in one way or another. Motion pictures, exhibits, displays, bill-boards, advertisements, booklets, pamphlets, leaflets, radio interviews and television shows, speeches, community luncheons and other special events will be utilized to invite the public's attention to the story of oil, and the amazing progress being unfolded by the industry.

The effort behind Oil Progress Week is supplied by the Oil Industry Information Committee of the American Petroleum Institute. Before the idea for this special observance was born, the Oil Industry Information Committee was composed of about 3000 oil men who were convinced that the American people should be told about the manifold activities of their great business, but who were sometimes discouraged because they could see few specific results arising from their hard work. Today, membership in the Oil Industry Information Committee has increased almost six-fold and its organization reaches into every state and almost every community in the nation. This has brought about a unity of purpose unusual for such a large industry.

In a statement on Oil Progress Week by Frank M. Porter, President of the American Petroleum Institute, he said that this remarkable unanimity of action has come about because Oil Progress Week has a two-fold purpose which some of us originally had tended to overlook. Not only does it inform the *public* of oil's progress, a task which he suggests should be the duty of every oil man who wants to see his company and his industry grow and prosper, but it also brings home to *oil men* themselves an awareness of their industry which comparatively few of them possessed in 1947.

It is not possible to praise too highly the API and the Oil Industry Information Committee for their diligent planning and hard work which are sure to make this tremendous undertaking a huge success.

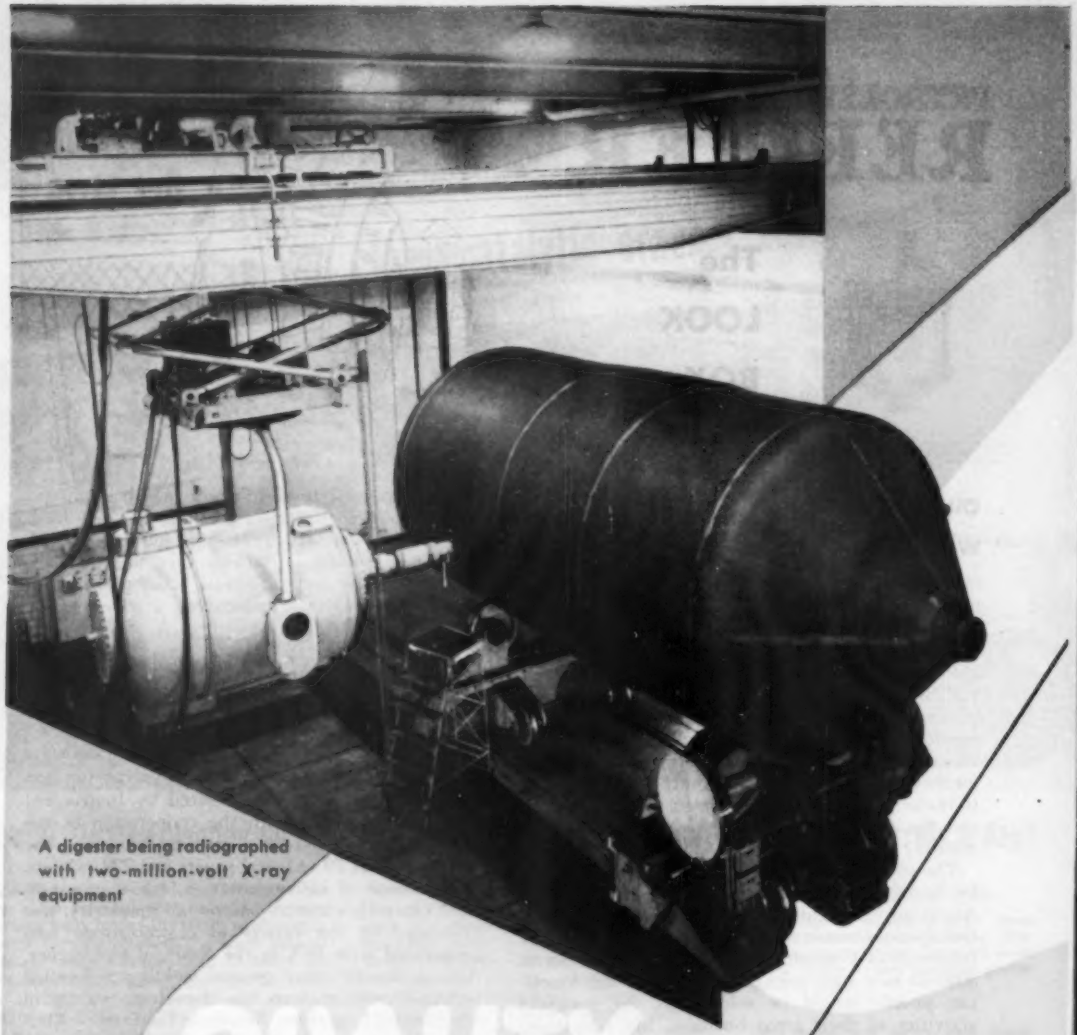
Onward Instrumentation

POINTING UP the importance of instrumentation to industry and government, the Sixth National Instrument Conference and Exhibit, held in Houston, September 10-14, drew the attention of more than 6800 attendants to climax the most successful year in its six-year history. Sponsored by Instrument Society of America with the cooperation of ten other organizations, the Conference featured the presentation of 79 technical papers and 229 exhibits.

The scope of instrumentation, whose ramifications extend horizontally across all industries, was evidenced by the variety of organizations who cooperated with ISA in the National Conference. Among the 10 other groups holding individual technical sessions were the American Society of Mechanical Engineers, American Institute of Electrical Engineers, American Institute of Physics, National Association of Corrosion Engineers, Texas A. & M. College, and the National Bureau of Standards.

Manufacturers' booths, filling the Sam Houston Coliseum and Music Hall to capacity, displayed the latest devices for measurement, testing, inspection, and control. Drawing more than average interest were the graphic panels for refinery control rooms. In addition to the manufacturers' booths were those occupied by the National Bureau of Standards and the U. S. Navy, which featured ordnance laboratory and research equipment.

The technical sessions included papers on instrumentation for production processes, testing, analysis, maintenance and operation, aviation, and geophysics. Of interest to refinery operating and maintenance personnel were the papers on kinegraphic control boards, instrument applications



A digester being radiographed with two-million-volt X-ray equipment

QUALITY

BY THE TON

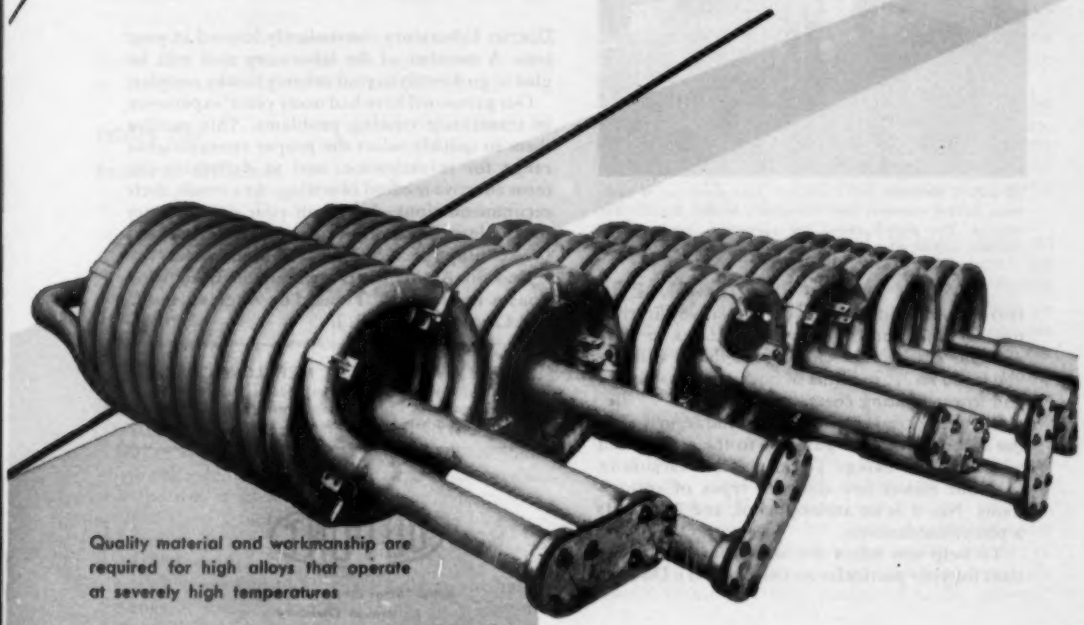
... process equipment by

B&W

Today, fabricating capacity and mechanical design facilities alone cannot provide an adequate solution to the equipment problems imposed by modern processing temperatures, pressures, and stepped-up cycles of operation.

Design and construction of vessels and heat-transfer equipment necessarily involve such relatively new research data as creep characteristics and the metallurgy and methods of welding dissimilar metals and alloys. B&W is particularly well equipped . . . both by research and experience . . . for the proper selection of materials, their fabrication, and integrated assembly to meet the special requirements of modern chemical, petroleum, and food processing.

No matter how "big" you buy, you can still think in terms of *quality* — fine engineering, conscientious craftsmanship, experience, and the ultimate in critical inspection — when B&W contracts for the job. The Babcock & Wilcox Company, 85 Liberty Street, New York 6, N. Y.



Quality material and workmanship are required for high alloys that operate at severely high temperatures

BABCOCK & WILCOX

S-4061

HOW Du Pont *CAN HELP YOU GAIN* maximum gasoline stability with minimum antioxidant treating costs

TO ASSIST REFINERS in the efficient, economical use of additives, Du Pont maintains five strategically located district laboratories. This picture shows the up-to-date, fully-equipped chemical section of the Houston, Texas, laboratory.

Have you recently evaluated the relative effectiveness of different Du Pont antioxidants in your gasoline stocks? The chances are that it will pay you to do so . . . in terms of both greater stability and lower treating costs.

Changing crude sources, for example, may alter the response of your gasoline to the antioxidant you are now using. To meet such variations, Du Pont makes two different types of antioxidants. No. 5 is an aminophenol, and No. 22 is a phenylenediamine.

To help you select the most efficient antioxidant for your particular stocks, there is a Du Pont District Laboratory conveniently located in your area. A member of the laboratory staff will be glad to go directly to your refinery to take samples.

Our personnel have had many years' experience in antioxidant treating problems. This enables them to quickly select the proper concentration range for investigation, and to determine the most effective method of testing. As a result, their recommendations—based on your own refinery processing operation—can be valuable in meeting stability specifications at minimum cost.

Du Pont Antioxidants are available from warehouses in Houston, Texas; Los Angeles, Calif.; and Carney's Point, N. J.

NOW AVAILABLE AT NEW LOW COST!
The price of all Du Pont Antioxidants has recently been reduced . . . write the nearest Du Pont district office listed below for full details.

DU PONT
REG. U.S. PAT. OFF.
Better Things for Better Living . . . through Chemistry

Petroleum Chemicals

E. I. DU PONT DE NEMOURS & COMPANY (INC.)
Petroleum Chemicals Division • Wilmington 98, Delaware

District Offices: New York, N. Y. · Chicago, Ill. · Tulsa, Okla. · Houston, Texas · Los Angeles, Calif.

District Laboratories: Wilmington, Del. · Chicago, Ill. · Tulsa, Okla. · Houston, Texas · El Monte, Calif.

IN CANADA: Canadian Industries Limited—Toronto, Ont.—Montreal, Que.

involving slurry and corrosive service, thermocouple checking, infrared analyzer applications, and recording titrometers.

The Texas A. & M. Symposium on Instrumentation for the Process Industries, incorporated for the first time in the National Instrument Conference, included papers on the complete instrumentation of a synthetic rubber plant and an oxygen plant, as well as optimalizing systems in process control and pneumatic operators for throttling service. Of special interest to petroleum refiners was the paper by E. D. Mattix on "Refinery Control Problems." Based on the practical approach of the case history method, this paper is presented in this issue of PETROLEUM REFINER on page 132.

In addition to the technical program, the Houston Conference was the scene of the Third Pre-Conference Instrument Mechanic's Maintenance Clinic. This unique educational feature is a once-a-year opportunity for 200 instrument mechanics to get 20 hours of instruction on "trouble shooting," repair, maintenance and installation of the instruments of 10 selected companies who participate in the Exhibit.

Attendance at this conference certainly left no doubt that instrumentation and automatic control is the keynote of modern industrialization.

Ethics For Federal Officials

A CODE OF ethics for federal officials, devised and enforced by themselves, would help curb immorality in government, D. A. Hulcy, president of the Chamber of Commerce of the United States, said recently. He said federal officials should realize that public service is a profession and requires a code of ethics, the same as other professions.

Recent scandals in public office, he declared, are evidences of "a moral defection that has run like a maverick thread through the whole fabric of our national life," and government officials have in some cases contributed to this condition, and in other cases have been quick to take advantage of it.

Citing weakened home ties, the high incidence of juvenile delinquency, the growth in sex crimes, and the toll of alcoholism and drug addiction as symptoms of a moral collapse, he listed as one of the causes, a gradual breakdown in historic national standards.

Hulcy suggested to a Senate Labor subcommittee considering a measure to establish a Commission on Ethics in the Federal Government, that a permanent agency of government officials be set up to enforce it by moral persuasion or other appropriate means. He said this is a job for federal officials, rather than private citizens, because pride of profession should be the motivating force.

Contending that a code is no better than the set of beliefs which underlie it, Hulcy said the real need is for a revival of those moral convictions which went into the formation of our Republic. The underlying cause of the moral breakdown has been a trend to materialism. Early Americans tried to develop their material well-being and their moral character simultaneously by hard work, self-discipline and respect for law and order, he said.

"Today we have achieved a standard of living which has become the envy of the world . . . but our moral advancement has not kept pace. We have mistaken material wealth, which should be a means to the higher life, as an end in itself."

Scrap Steel For Defense

RECORD-BREAKING steel production and continued large-scale expansion of productive capacity have forced the scrap inventories of American steel mills and foundries to a dangerously low level. Hence, a program to recover heavy dormant iron and steel scrap is needed to 1) maintain and increase America's unprecedented level of mill and foundry production, 2) conserve diminishing supplies of high-grade raw materials (wherever one ton of scrap can be used in place of one ton of pig iron, four tons of raw materials are saved), and 3) quickly increase the current dangerously low inventories to the normal 60-day supply to help carry the mills and foundries through the coming winter months when seasonal collections normally fall off.

These steel facts are emphasized in a booklet prepared by the National Production Authority, U. S. Department of Commerce. The oil refining industry, along with all other industries, is urged to make every effort to salvage all available scrap and get it back into circulation.

Rewards Of Socialism

SOCIALIST planners leave no stone unturned in their search for things to plan. A new British magazine, *Individualism*, tells us that the Royal Commission on Capital Punishment spent two years studying all the intricacies of the death sentence, and came up with the fascinating suggestion that radio sets be installed in the death cells on the eve of the execution, "in which case programs would be carefully selected." Who is to select the programs? Not the miserable listener, but one of the planners, who decides, in his wisdom, what a condemned man would like to (or at any rate, should) listen to in his last hours. As *Individualism* says, "we have moved beyond the helpless delights of 'the cradle to the grave,' and officials now draw their salaries all the way from pregnancy to the gallows."

"To keep America strong and safe, it is absolutely essential that the search for new supplies of oil and gas continue at a high level. The number of wells drilled, and the expansion of transportation and processing facilities, depend primarily on two things: an adequate steel supply and consistently sound government policies in the field of taxation and regulation."

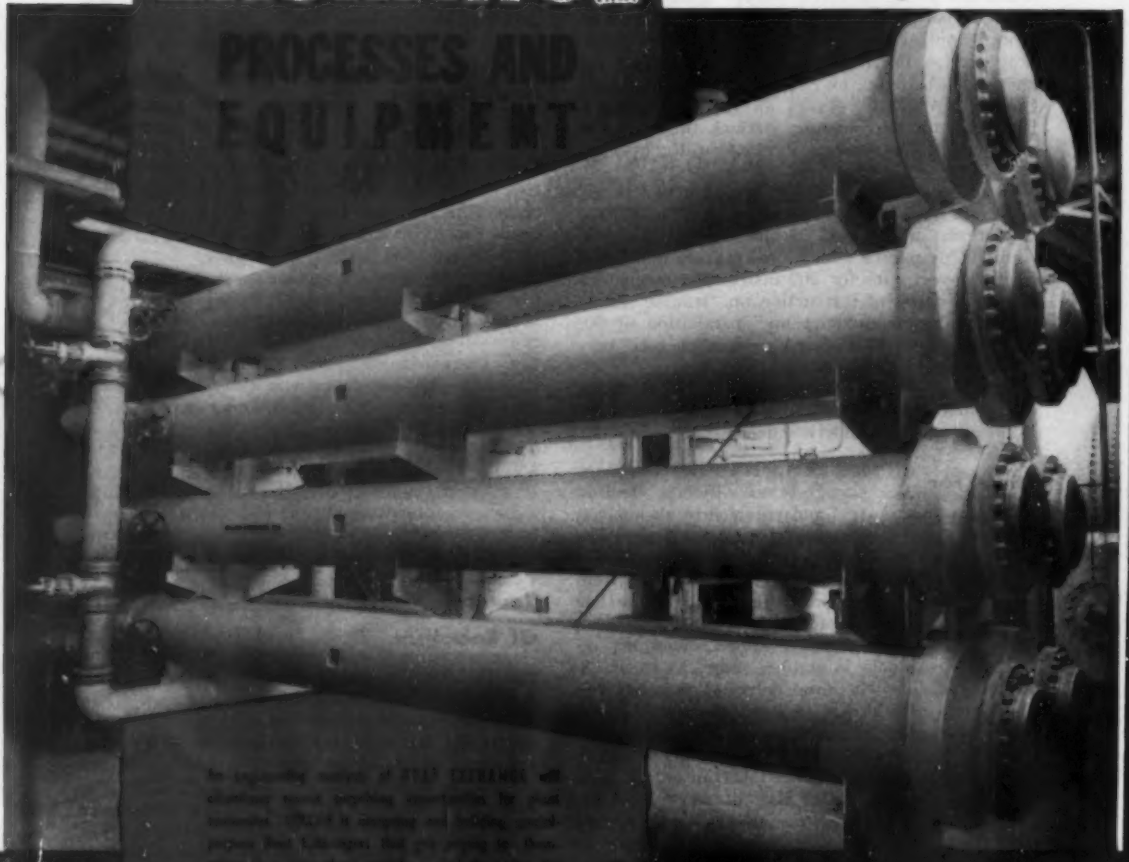
A. R. CARMODY, president,
Louisiana-Arkansas division,
Mid-Continent Oil and Gas Association.

HEAT EXCHANGE

PROCESSES AND EQUIPMENT

50th Anniversary

1901 1951



Heat Exchange unit with transfer surface of 2,650 sq. ft. for production of Ethyl Alcohol.

ENGINEERS AND MANUFACTURERS OF PROCESS PLANTS AND EQUIPMENT

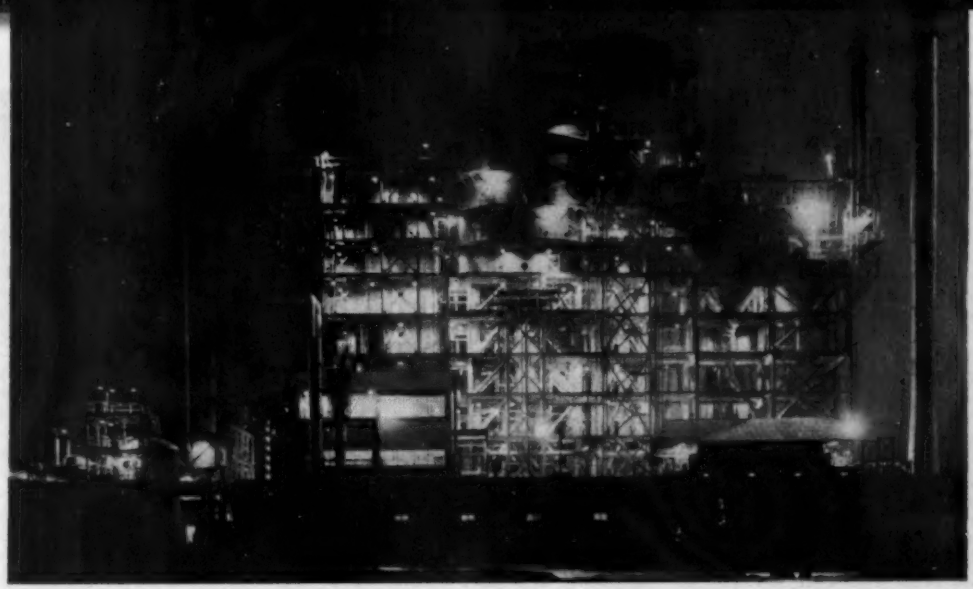
VULCAN CINCINNATI

THE VULCAN COPPER & SUPPLY CO.

General Offices and Plant, CINCINNATI 2, OHIO

PHILADELPHIA BOSTON SAN FRANCISCO BUENOS AIRES

VICKERS VULCAN PROCESS ENGINEERING CO., LTD., MONTREAL, CANADA



Anglo-Iranian's new catalytic cracker, which started operations only last April, is shown above. The refinery has been the center of the dispute between Great Britain and Iran over oil nationalization by Iran.

European Refining and Crudes from the Middle East

GUSTAV EGLOFF

Universal Oil Products Company, Chicago

ONE OF THE world's greatest sources of economic wealth is the potential 200 billion barrels of oil credited to Middle East oil fields, at an estimated value of more than $300 billion. Proven reserves are over 40 billion barrels of oil, or about 46 percent of the world's proved deposits. (The U. S. has about 30 billion barrels of proved oil reserves and 100 billion barrels potential.) The vast oil richness of the Middle East countries, Iran, Saudi Arabia, Kuwait, Iraq, Qatar, and Bahrein is reflected in the average daily rate of production during 1950 which was 1,700,000 barrels from 315 wells averaging 5400 barrels each. In contrast, the U.S.A. averages 12 barrels a day from its 444,000 producing wells or a total of about 5,400,000 a day.

Problems in connection with producing, refining and transporting oil vary with the different countries in the Middle East. The following discussion summarizes the status of the industry in each country.

THE MIDDLE EAST has the greatest reservoir of oil known in the world today. This oil resource must be protected as one of the most important factors in the security of Western civilization. The Western oil companies have through their enormous investments in manpower and money made the development of this great wealth possible. This is a condensation of a paper presented by Dr. Egloff before the 49th Annual Meeting of the National Petroleum Association in Atlantic City, September 12, 1951.

Iran

The seven oil fields of Iran cover about 250 square miles of a total concession of 100,000 square miles. Proved reserves are 13 billion barrels. Operations have been carried on exclusively by Anglo-Iranian Oil Company. The only other active oil company is Iran Oil Company, formed by the government in 1949 to explore outside AIOC's 100,000-square-mile concession.

Daily production in 1950 was at the rate of 665,000 barrels from 77 wells, or over 8500 barrels per well per day. The greatest oil field in Iran is the Agha Jari discovered in 1937. At the end of 1950, production was 370,000 barrels a day from 16 wells, or an average of 23,000 barrels per well per day. The gravity of the various crudes ranges from 33 to 43 API, averaging 37. The Masjid-i-Sulaiman, which after 39 years is producing an average of 2100 barrels per well per day, is testimony of the long life of the fields.

The pipe line system is interlaced from field to field to the Abadan refinery and Bandar Mashur, both export terminals. The modern and complete refinery at Abadan, the largest in the world, processed about 560,000 barrels of crude into 90,000 barrels a day of motor fuel, 18,000 barrels a day of aviation gasoline, as well as kerosine, diesel oils and jet fuel. Operations included a 35,000-barrel-a-day Fluid catalytic cracking plant, three alkylation units and a 400-barrel-a-day lubricating oil plant, etc.

It is unfortunate that the highly integrated and efficient operations of AIOC in Iran have been lost to the world even if only for a temporary period of time. It is hoped that efforts being made towards a satisfactory solution to the problem will soon restore the Anglo-Iranian production of refined products and crude oil to world markets.

Iraq

The geological conditions of Persia were found to be continued into Iraq.

The proved oil reserves of 8.25 billion barrels occupy an area of 132 square miles. There were ten wells, producing 159,000 barrels daily at the end of 1950, or at the rate of about 16,000 barrels per well per day. There are also 29 shut-in wells and 15 observation wells.

Iraq production has come entirely from the Kirkuk field, although some heavy oil has been discovered in the Mosul area from shallow wells. The new Basrah field will be in operation shortly when the pipe line is finished to Fao on the Persian Gulf.

Refining capacity in Iraq is small and most of the oil produced must be transported by pipe line to Palestine, Lebanon or Syria. Two parallel lines carry 160,000 barrels per day of crude from Iraq to Tripoli, Lebanon. Upon completion of an additional line to Haifa, Palestine the capacity will have been increased to 150,000 barrels daily. A 30-inch pipe line from Kirkuk to Banias, Syria, under construction, will bring the total transportation from Iraq to a potential 610,000 barrels per day. This line will be ready in July, 1952.

It is hoped that the Iraq government ban will be lifted soon and Iraq oil will again flow to the 85,000-barrel refinery at Haifa. Haifa's source of oil through the Suez canal from the Persian Gulf has also been cut off. It is receiving about 20,000 barrels a day by tanker transportation around Africa and through the Mediterranean. At present it is receiving crude from Venezuela.

Saudi Arabia

The king of Saudi Arabia granted a concession covering 440,000 square miles to the Standard Oil Company of California in 1933. Exploration and drilling were discouraging until 1936 when the Damman field was brought in. The daily production of Saudi Arabia at the end of 1950 was 618,000 barrels a day, which was stepped up during July of this year to an average of 820,000 barrels per day. Proved reserves have been estimated at 9.2 billion barrels, but new fields are being discovered from time to time.

There are three oil producing fields, with a total of 103 producing wells averaging about 6400 barrels per day per well.

A new oil field was also discovered about two miles out in the Persian Gulf. This means a second new field this year, or a total of nine. The estimated proved area of the nine oil fields is approximately 300 square miles.

Aramco has a refinery located at Ras Tanura, which was built for military purposes in 1943-45. A substantial portion of the output of the refinery is for the United States Navy. It had a crude run of 157,000 barrels per calendar day for the first six months of 1951, and more recently has been operating at even higher capacities to offset particularly the loss at the Abadan refinery in Iran.

The population of Saudi Arabia is estimated to be 6 million more or less, and domestic consumption of oil is small. The major part of the production and products is exported.

One of the greatest engineering feats of our time has been the Trans-Arabian pipe line which was completed in 1950 at a cost of about $230 million. This 30-31-inch pipe line is 1068 miles long, and extends from the Persian Gulf through boiling desert to Sidon, Lebanon on the Mediterranean. The capacity of the pipe line is over 300,000 barrels a day which could be increased by additional pumping equipment. This pipe line eliminates a 20-day, 7000 mile trip around the Arabian peninsula through the Suez Canal into the Mediterranean and return. It replaces 65 tankers and saves large sums in toll. The Suez Canal carries a toll of 18 cents a barrel—hence, a daily saving of $54,000 on that expense alone.

Kuwait

The entire sheikdom of Kuwait is under lease to Kuwait Oil Company, on a 75-year concession which was granted in 1934. The Burghan field, which is the only one producing at present, was considered the largest single oil field ever discovered in the world. It has estimated proved oil reserves of 15 billion barrels in about 90 square miles. By comparison, the famous East Texas field is estimated to have had only 5 billion barrels at the outset.

Kuwait operations were almost discontinued in 1942 because of the war and actual commercial production did not begin until 1946. In July, 1951, 650,000 barrels a day were produced from 94 wells, or an average of about 7000 barrels per well per day, with 16 wells kept in reserve.

A 25,000-barrel a day refinery is in operation in Kuwait to supply local needs and fuel for visiting tankers. Export is by tanker only, but a pipe line project has been under discussion to transport the oil from Kuwait on the Persian Gulf to the Mediterranean.

Qatar

The sheikdom of Qatar has granted the Petroleum Development Company (Qatar), Ltd., a 75-year lease on the entire peninsula. By later agreement, all offshore territory within three miles is included. Offshore territory from three to twelve miles is included in a concession held jointly by the Superior Oil Company and the Central Mining and Investment Syndicate, a London firm. In 1950, production averaged 33,000 barrels daily and 1951 output is something less than 50,000 barrels per day, about 50 percent more than in 1950.

Bahrein

Bahrein, a small insular sheikdom, is about 20 miles off the Saudi Arabia shore. A concession was granted to Bahrein Petroleum Company, owned by Standard of California. The Texas Company joined Standard of California in the ownership of Bahrein in 1930. The original concession has been extended to 1995 and covers the entire sheikdom. The field now consists of 69 wells and production is slightly over 30,000 barrels per day or an average of some 440 barrels per day. Total production in 1950 was 11,015,711 barrels.

The Bahrein Island refinery is now one of the most important in the Middle East. Its capacity exceeds 175,000 barrels per day. It processes the entire Bahrein production and more than 145,000 barrels of crude which comes from Saudi Arabia. Facilities include thermal and catalytic cracking units, aviation gasoline manufacturing units, an SO_2 plant, an asphalt plant and others.

Middle Eastern Exports to Europe

Just before the Iranian crisis, 875,000 barrels of crude oil or about 44 percent of the total production was being exported to Western European refineries. Of this total, 125,000 barrels of crude came from Iran. Exports of refined products were at the rate of 175,000 barrels per day from the Middle East, 135,000 of which come from Iran. These exports of crude oil and refined products accounted for about 90 percent of the total West European demand. Increases in exports from countries other than Iran will be necessary not only to make up the deficit caused by loss of Iranian crude and refined products but also to meet growing West European demands. The rise in demand will be principally for crude oil to feed European refineries now being constructed.

European Refineries

In western Europe most of the refinery capacity was destroyed by bombing and after the war rehabilitation of old and construction of new refineries was needed to assist economic recovery. European nations wanted to be self-sufficient in regard to refined oil supplies, and the ECA was willing to assist. It was believed that if European imports of refined products could be minimized and crude oil imported for refineries to manufacture such products for domestic consumption, the dollar shortage in Europe could be greatly lessened and a better trade balance established. Of the $235 million capital expenditures necessary for refinery expansion, the ECA

AMERICAN METER COMPANY'S

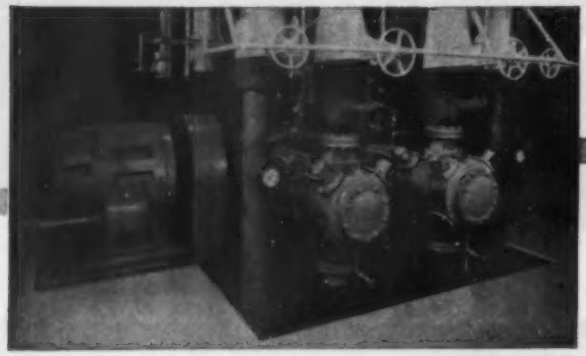
New Dallas Plant

New Convenience for the Southwest Area

You are cordially invited to visit our new plant and showroom at 1300 Industrial Boulevard, Dallas. Designed to specialize in the production of Orifice Meters and related equipment, it speeds deliveries and makes possible a personalized, sales-engineering service including consultations on instrument problems. The new showrooms afford complete facilities for conducting Instrument Schools for engineers and maintenance men. The complete line of American Meter Company products will also be on permanent display.

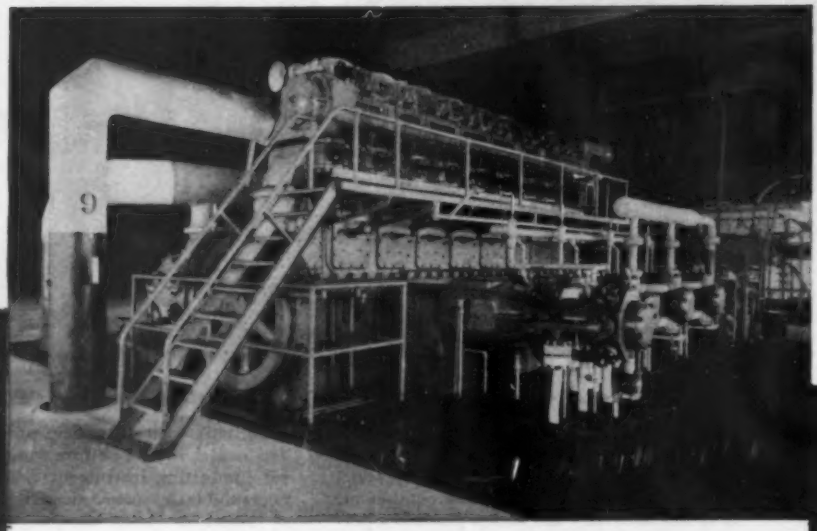
AMERICAN METER COMPANY
INCORPORATED (ESTABLISHED 1836)

GENERAL SALES OFFICE: 1513 Race St., Philadelphia
Albany • Alhambra • Amarillo • Atlanta • Baltimore
Birmingham • Boston • Chicago • Dallas • Denver
Erie • Houston • Kansas City • Los Angeles • New York • Odessa • Pittsburgh • San Francisco • Tulsa
Canadian Meter Co., Ltd., Hamilton, Ontario

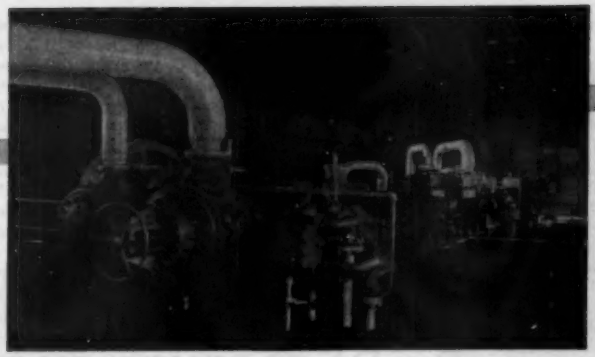


Clark CMA-4, 300 bhp, 600 rpm, balanced/opposed motor-driven compressor, performing two compression services at Spencer Chemical Co. dry ice plant: Two cylinders in main or liquefaction service compress carbon dioxide through two stages from a suction pressure of 20 psig to a discharge pressure of 345 psig, and two cylinders in recycle service compress carbon dioxide two-stage from 0 psig to 345 psig discharge pressure.

5 types of compressors at Spencer Chemical, signify . .



One of nine Clark SCRA, 2750 bhp, steam-engine-driven compressors, handling feed gas for ammonia manufacture at Spencer Chemical Co. Compression through six stages is from atmosphere to 5500 psig discharge pressure.



Two Clark CRA-6, 1750 bhp, 327 rpm, balanced/opposed motor-driven compressors, compressing hydrogen and carbon monoxide feed gas from atmospheric pressure to a discharge pressure of 5150 psig at Spencer Chemical Co. End product: Methanol.

. . . Clark Versatility!

It may be said that the list of compressors in service at the Jayhawk Works of Spencer Chemical Company reads like a Clark catalog. For there are sixteen Clark compressors, representing five basic models, shouldering the main compressor requirements of this Pittsburg, Kansas plant.

But the significant aspect of these Spencer installations is not the *number* of Clark units involved, rather the *versatility* of the Clark line that enables complete fulfillment of any and all requirements—no matter how diversified!

In this one plant, for example, are two Clark CRA-6, balanced/opposed motor-driven compressors; a Clark CMA-4, balanced/opposed motor-driven unit; and nine Clark SCRA, steam-engine-driven models (all illustrated and described herewith); as well as three Clark MA-4 and one Clark RAS-6, gas-engine-driven compressors (not shown).

All of which means simply this: No matter how difficult the problem . . . how specialized the function . . . how diversified the conditions . . . compressor requirements are met completely and most competently by Clark. For, by reason of the versatility of its line, Clark is in the favorable position of being able to recommend without bias and build to anyone's best interests and preferences.

Your nearest Clark representative has data and literature to support these claims.

CLARK

COMPRESSORS

TABLE 1
European Demand and Refinery Production[1]
(Barrels per day)

	Prewar	1951	1952-53 (Fiscal)
Demand	530,000	1,125,000	1,220,000
Refinery Prod.	240,000	1,039,000	1,184,000

[1] Data obtained from O.E.E.C., 2nd Report on Coordination of Oil Refinery Expansion.

has supplied $35 million up to December 31, 1950. A major portion of the refinery expansion has been made by European subsidiaries of U. S. companies.

A brief summary of European petroleum product demands and refinery production prewar, and in 1951 with estimated figures for the 1952-53 fiscal year is given in Table 1. The 1951 western European demand for petroleum products is twice that of the prewar years.

Refinery thruputs will have increased nearly 5.5 times over prewar by 1952-53.

Table 3 gives the estimated thruput of western European refineries in 1952-53 by countries.

Western European consumption of refined products, a prewar average, the actual consumption for 1948-49 and 1949-50 and the anticipated demand for three succeeding fiscal years are given in Table 4.

As a result of the modern refinery expansion program, the United Kingdom, France, Italy, Western Germany and Holland will soon be able to supply their domestic demands for refined products from their own refineries. In the United Kingdom, large refinery expansion projects are under way at Grangemouth in Scotland and in Kent. Fawley, at Llandarcy in Wales, at The Fawley refinery, the largest in Europe, is being constructed by the British subsidiary of Standard Oil Company (New Jersey) and will shortly be in full operation. It operates on Middle East crudes and will require 126,000 barrels per day. The catalytic cracking plant has a capacity of 41,000 barrels a day. The lubricating oil capacity will be 4000 barrels a day. Two thermal reforming units will be used to improve the octane rating of straight-run gasoline.

In France 300,000 barrels a day of crude oil were refined in 1950, 27 percent more than in 1949. For the year 1950-1951, 360,000 barrels per day were processed. French refineries are now supplying all of the domestic demand for refined products with the exception of small amounts of specialties and are exporting to adjoining countries as well.

Germany's total refining capacity will be 127,000 barrels per day in 1952-53. The refineries include facilities for hydrogenating 30,000 barrels a day of residual fuel oil. By 1952, it is expected that present cracking capacity of 20,000 barrels a day will be increased by an equal amount in thermal cracking and 24,000 in catalytic cracking capacity. Germany has the largest lubricating oil capacity in Europe, 9200 barrels a day.

In Italy the refinery capacity is to be augmented by 40,700 barrels per day to reach a total of 193,800 barrels by mid-1953. At five different localities, new units are planned or under construction. The largest of these is at Milan, where the capacity will be 30,000 barrels a day.

The necessity of refining expansion to meet rising requirements for petroleum products is particularly well illustrated by data on lubricating oil imports and production. Demand for lubricating oils in European countries in 1950 was about 39,000 barrels a day. The imports of lubricating oils into western European countries in 1949 and 1950 are given in Table 5.

TABLE 2
Crude Oil[2]
(Barrels per day)

	Prewar (Average)	1948-49	1949-50	1950-51	1951-52	1952-53
Refinery Thruput	240,000	460,000	624,000	936,000	1,149,000	1,302,000
Refinery Output	224,000	418,500	582,500	880,000	1,042,000	1,185,000

The refinery throughput and output of western European countries is given by the O.E.E.C. in their second report on coordination of oil refinery expansion, dated August, 1951. These data are given in Table 2. The last three columns show the anticipated quantities through the fiscal year of 1952-53 as estimated in December, 1950.

TABLE 3
1952-53 Estimated Thruput[1] of European Refineries
(Barrels per day)

COUNTRIES	Barrels Per Day
United Kingdom	426,000
France	339,000
Italy incl. Trieste	193,800
Benelux	162,000
Germany	127,000
Sweden	25,000
Portugal	6,400
Switzerland	2,000
Turkey	1,200
Norway	800
Denmark	600
Total	1,303,400

TABLE 4
Total Domestic Consumption of Finished Products[1]
(Barrels per day)

	Pre war (Average)	1948-49	1949-50	1950-51	1951-52	1952-53
Motor Gasoline	278,500	349,000	384,000	349,000	377,100	394,000
Kerosine	45,500	62,900	62,900	66,200	71,300	76,000
Gas/Diesel Oil	51,600	160,800	190,500	224,200	242,000	258,000
Fuel Oil	101,300	202,500	244,000	286,500	316,000	352,000
Lubricants	30,700	28,800	36,400	38,350	40,250	42,200
Miscellaneous Products	43,400	63,100	75,000	86,900	98,700	112,300
Total	851,000	767,000	892,700	1,054,060	1,145,480	1,236,500

TABLE 5
Imports of Lubricating Oils[1]
(Barrels per day)

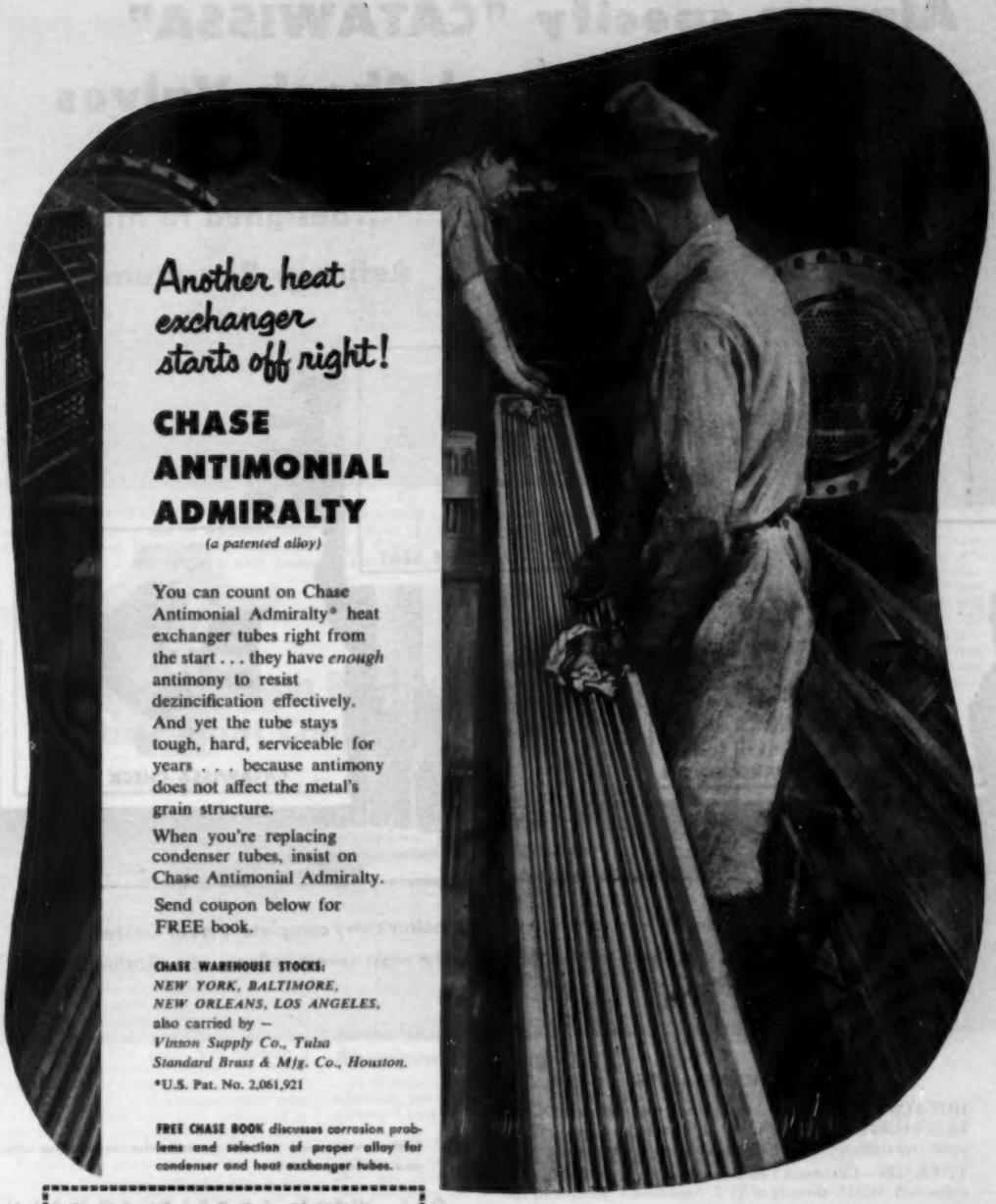
	1949	1950
U. K.	5,650	8,400
France	1,248	1,180
Netherlands	1,323	1,710
Italy	1,440	1,840
Sweden	613	1,210
Western Germany	192	211
Belgium-Luxembourg	1,305	2,050
Denmark	518	748
Norway	633	894
Switzerland	441	748
Ireland	268	268
Portugal	249	192
Total	13,880	19,181

[1] Petroleum Press Service, March, 1951. P. 81.

Summary

While the refinery expansion program for Western Europe when completed, will decrease imports of refined products—the demand for crude will increase markedly. Although it is generally agreed that crude production in other Mid-Eastern countries can be increased sufficiently to offset the loss of Iranian crude, the shutdown of the Abadan refinery products is not so readily replaced.

The Middle East has the greatest reservoir of oil known in the world today. This oil resource must be protected as one of the most important factors in the security of Western civilization. The western oil companies which have opened this miracle of wealth are entitled to a reasonable profit from their enormous investments in manpower and money. To continue this development, they must have a sense of security in their investments, in the sanctity of contracts, a faith in the survival of our moral world.



Another heat exchanger starts off right!

CHASE ANTIMONIAL ADMIRALTY

(a patented alloy)

You can count on Chase Antimonial Admiralty* heat exchanger tubes right from the start . . . they have *enough* antimony to resist dezincification effectively. And yet the tube stays tough, hard, serviceable for years . . . because antimony does not affect the metal's grain structure.

When you're replacing condenser tubes, insist on Chase Antimonial Admiralty.

Send coupon below for FREE book.

CHASE WAREHOUSE STOCKS:
NEW YORK, BALTIMORE, NEW ORLEANS, LOS ANGELES,
also carried by —
Vinson Supply Co., Tulsa
Standard Brass & Mfg. Co., Houston.

*U.S. Pat. No. 2,061,921

FREE CHASE BOOK discusses corrosion problems and selection of proper alloy for condenser and heat exchanger tubes.

Chase Brass & Copper Co., Dept. PR 1051
Waterbury 20, Conn.

Please send me Free Book on Condenser and Heat Exchanger Tubes.

NAME_____

POSITION_____

FIRM_____

STREET_____

CITY_____ STATE_____

Chase BRASS & COPPER

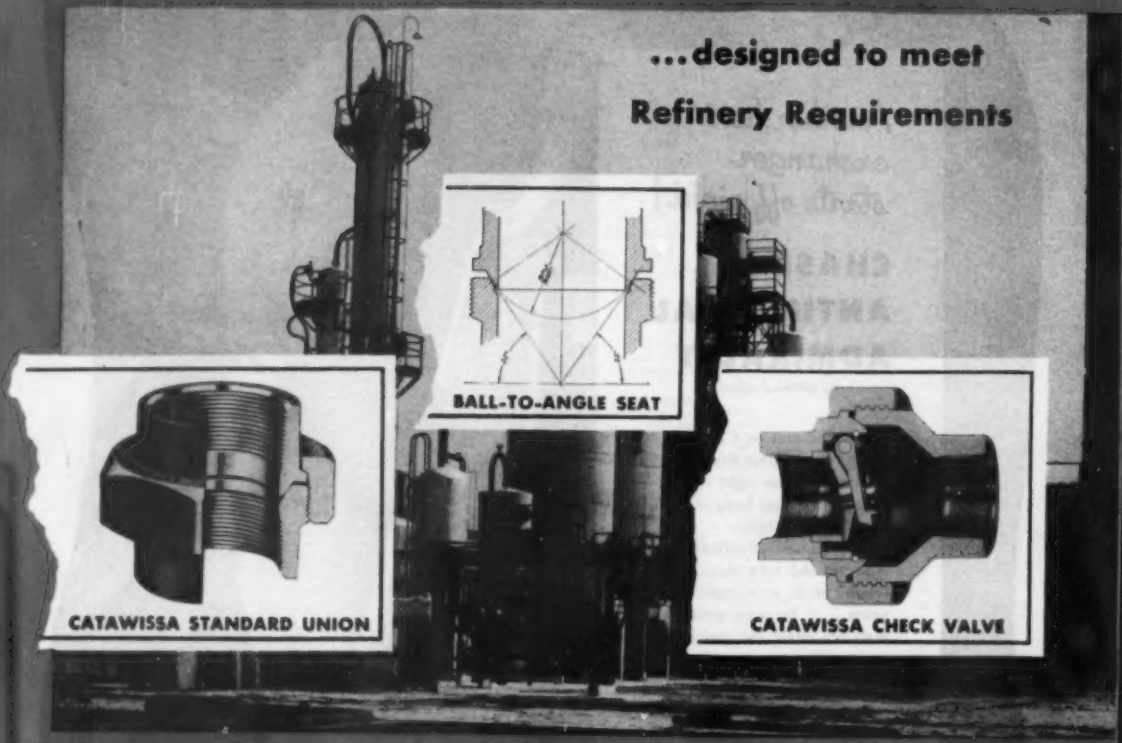
WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION

• *The Nation's Headquarters for Brass & Copper*

Albany† Atlanta Baltimore Boston Chicago Cincinnati Cleveland Dallas Denver† Detroit Houston† Indianapolis Kansas City, Mo. Los Angeles Milwaukee Minneapolis Newark New Orleans New York Philadelphia Pittsburgh Providence Rochester† St. Louis San Francisco Seattle Waterbury (Tubes office only)

CHASE 75th ANNIVERSARY 1876 1951

Always specify "CATAWISSA" Unions and Check Valves



"OILWELL'S" strategically located refinery stock points carry complete lines of Catawissa forged-steel unions and check valves that meet the most severe refinery specifications.

CHECK THESE FEATURES

HOT-FORGED . . . from solid, rectangular steel bars, Catawissa Unions are free from sand and blow holes. They will expand and contract with the pipe, assuring tight joints.

THREADS—Catawissa Unions and Valves are supplied with either full ACME threads or U. S. Standard V-threads in the union nuts and on the female end.

SEATS . . . in all Catawissa Unions are a 55° angle on the female end to a BALL on the male end, assuring a perfect seal even when the pipe is not perfectly aligned. Carefully hand-ground seats which require no packing are inspected and tested under water to assure holding qualities.

Contact your nearest "Oilwell" representative—to assist you with your refinery problems.

OIL WELL SUPPLY COMPANY

Branches Serving All Oil Fields

Executive Offices—DALLAS, TEXAS
Export Division Office—
30 ROCKEFELLER PLAZA
NEW YORK 20, N. Y.

Division Offices—CASPER, WYOMING
COLUMBUS, OHIO . . . DALLAS, TEXAS
HOUSTON, TEXAS . . . TULSA, OKLAHOMA
LOS ANGELES, CALIFORNIA

USS "OILWELL"

UNITED STATES STEEL

ON STREAM IN YEAR—This Fluid catalytic cracker currently going up in Llandarcy, Wales, is expected to be on stream by September, 1952. It is one of three units designed by The M. W. Kellogg Company, New York, for Anglo-Iranian Oil Company. Similar 10,000-barrels-per-day units will be in Kent, England and Grangemouth, Scotland.

News Notes on Refinery and Other Plant Construction

Petroleum Refiner's Quarterly "Box Score"

Tabulation Appears on Page 86

Sunray Begins 25,000 BPD Corpus Christi Refinery

Final plans for a 25,000 barrel per day catalytic cracking refinery for Sunray Oil Corporation's Corpus Christi refinery went to the drawing board for last-minute adjustment when the Defense Production Administration issued a recent certificate of necessity to cover the construction. The plant will include a UOP fluid catalytic cracker, a UOP hydrofluoric acid alkylation unit, a UOP thermal cracker, gas concentration unit, UOP phosphoric acid unit, polymerization unit and completed utilities, crude and vacuum unit, and Petreco Desalters.

Preliminary estimates for the project, including additional tankage and a line to the dock and barge facilities, run in excess of $10 million. When completed the refinery will produce aviation gasoline ranging from 115 to 145 octane at a daily rate of approximately 1600 barrels daily. Total output of gasoline is estimated at 14,000 barrels daily.

Deep Rock Adds Packaging Blending Plant at Cushing

Construction is under way on a new blending and packaging plant at Deep Rock Oil Corporation's Cushing, Okla., refinery. The chemical plants division of Blaw-Knox Construction Company is building the 400 barrel-a-day unit for motor oils and greases. When completed late this year, the plant will process about one-third of the Cushing output of lubricating oils.

Alcoa Starts Texas Aluminum Smelting Unit

It is expected that the new aluminum smelting plant being built by the Aluminum Company of America at Rockdale, Texas, will be in partial operation by late 1952. Survey work was completed last month and construction will probably get underway this month. When full operation is reached in 1953, approximately 170 million pounds of aluminum will be produced annually.

Alumina will be shipped to Rockdale from Alcoa's bauxite refining plant at Mobile, Ala., and from a new plant of similar type now being built by the company in Arkansas. John D. Harper, assistant district power manager for Alcoa's Tennessee operations, has been named works manager for the Rockdale plant, and Len B. Neubert, of the company's Vancouver, Wash., works, was appointed construction superintendent for erection of the plant.

Colombian Refinery to Gain 13,000 BPD Capacity

Last month the International Petroleum Company, Ltd., an affiliate of Standard Oil Company (New Jersey) handed the De Mares Concession rights back to the Colombian government at the expiration of the original contract terms. The 22,000 barrel-a-day refinery at Barrancabermeja which reverted to the Colombian government agent Empresa Colombiana de Petroleos, will be independently operated by International Petroleum Company, Ltd., for the next ten years. International will pay Empresa a fixed annual amount, plus fees varying with the quantity of crude processed. Empresa has promised to modernize the refinery, increasing its capacity to some 35,000 barrels daily. The modernization program figure is expected to run about $25 million.

Indiana Standard Begins Sulfur Extraction Unit

Standard Oil Company (Indiana) has begun construction of a 55-ton-per-day elemental sulfur plant at Whiting. The Flour Corporation, Ltd., is building the new plant which will extract hydrogen sulfide from by-product fuel gases produced in the adjacent refinery and convert it into elemental sulfur of 99.9 percent purity. It is expected the plant will be completed and in operation by the middle of 1952. Most of the Whiting production will be converted to sulfuric acid on existing plant facilities for use in alkylation and treating operations.

TGT's Kentucky Stripping Plant in Initial Operation

Construction of initial units of a $10 million Tennessee Gas Transmission Company liquid hydrocarbon recovery plant near Gabe, Ky., has been completed and operation has begun on a limited scale. The plant will process a large portion of the natural gas passing through the Tennessee Gas pipeline system toward the Appalachian area and the East. Activity and production will increase later in the year as additional units are completed at the recovery plant and at the new chemical plant of the Mathieson Hydrocarbon Chemical Corporation, which will take all of the output of the gas plant.

When in full operation, the stripping plant will process about 750 million cubic feet of gas daily.

Texas City Refining Requests Expansion Permit

An expansion move that is "entirely in the blueprint stage" is being contemplated by Texas City Refining Company pending word from Washington on the firm's application for approval of the $3 million program. The plan includes a general modernization of units for the 50,000 barrel refinery which was closed for about fourteen months just prior to the time that Texas City took it over from Petrol Refining, Inc., last Spring.

N. M. Expansion Complete

Completion of the 1200 barrel-per-day expansion at its Monument, N. M., refinery was confirmed by Famariss Oil

Company recently. Engineering on the $80,000 project was carried out by Refinery Engineering Company; construction by the Famariss staff.

New Petro-Chem Plant Projected for Houston

The Defense Production Authority has issued a certificate of necessity authorizing a fast tax write-off of 50 percent of the cost of a $38.3 million plant to be erected by Alamo Chemical Company on the Houston Ship Channel. Alamo is a new petroleum chemical firm organized by General Aniline & Film Company, Borden Company, and Phillips Chemical Company.

The parent firms claim the plan is still "in the conversation stage" but it is understood that Alamo has retained an engineering firm "to size up the potential" of the projected plant. If constructed, the plant will produce anhydrous ammonia.

Eastern States Expands Houston Plant Flexibility

Platforming and alkylation units designed by Universal Oil Products are being installed in Eastern States Petroleum Company's Houston refinery. The platforming unit has a feed capacity of 4200 barrels-per-day and will represent an investment of $1.5 million. The probable completion date for this unit is mid-December.

Work on the 2400 barrel-per-day hydrofluoric alkylation unit was held up pending PAD approval but the unit is expected to be completed about four months after construction begins.

Alberta Petro-Chemical Plant Progressing Rapidly

"Well under construction" is the progress report from Canadian Chemical Company's $50 million Edmonton, Alberta, petro-chemical plant. When completed in about 18 months, the plant will produce a variety of industrial organic chemicals by a process based on the oxidation of liquefied petroleum gases. It will also have units for the production of cellulose acetate, staple fibre and filament yarn. The plant will use 75,000 gallons per day of petroleum gases from Alberta oil fields as feedstock.

15,000 BPD Refinery Is Planned for Concon, Chile

Empresa Chile Nacional de Petroleo has secured a private loan of $2 million U. S. to build a 15,000 barrel-a-day refinery at Concon, Chile, according to reports. The plant will operate on Tierra del Fuego crude.

Spain Orders Equipment For Oil from Shale Plant

The Spanish government has authorized the importation of equipment for a hydrogenation plant which will be built by the Empresa Nacional Calvo Sotelo next year at Puertollano. The project calls for the treating of crude shale by hydrogenation to obtain the following annual output: 155,000 barrels gasoline, 415,000 barrels gas oil; 24,500 barrels transformer oil; 18,000 barrels light lubricants; 200,000 barrels machinery lubricants; 7000 tons grease; and 15,500 tons paraffins.

A new 50,000 kw steam-turbine power plant has been put in operation at the Puertollano deposits which are estimated to contain more than 120 million tons of shale, 95 million tons of which are considered workable.

Spain's shale deposits near Puertollano in the province of Ciudad Real, south of Madrid, are said to be among the world's largest and were entrusted to the state organization, Instituto Nacional de Industria in 1944. The Empresa Nacional is a subsidiary of the Instituto Nacional de Industria. In 1948 it was reported that exploitable layers of the deposit, per ton, would yield 11.5 percent of oils, 1.5 percent of scrubbed gasoline, plus eight kg. of ammonium sulfate.

Shale oil extractions have in general proved uneconomic, and for the great part exist only because of government subsidy. Sweden, Estonia and Brazil have small scale, government-subsidized operations. Australia recently closed down its Glen Davis shale plant for economic reasons.

Israel Seeks Capital to Finance Detergent Unit

Utilization of Israel's refining capacity is projected by that country's government under a program to build a petrochemical industry. A $2.5 million polymerization and alkylation plant for the production of detergents is planned as an addition to the refinery existing at Haifa. Raw material for the proposed plant would be supplied by the refinery in the form of liquid propane, a product of the refinery cracking unit.

To be designed for an annual output of 3000 to 3500 tons annually, it is estimated that two-thirds of the detergent products would be required to meet domestic needs and the rest would be available for export.

Of the $2.5 investment capital required, about $1.5 million would have to be invested in foreign currency for purchase abroad of necessary machinery and equipment. The Israeli government is currently encouraging private capital to participate in the program.

Caltex Plans 13,000 BPD Diesel, Fuel Oil Plant

Caltex has announced plans to erect a 13,000-barrels-a-day manufacturing plant for the production of diesel and fuel oil. The $5.8 million plant is to be erected at Sidon, Lebanon, and if plans materialize on schedule, the plant will be in operation by Fall, 1953.

Duncan Refinery on Stream

Sunray Oil Corporation has begun operation of the former Rock Island refinery at Duncan, Okla., which they leased and rehabilitated recently. Gas oil from the 7000 barrel Rock Island crude cracking unit will be used as feedstock for Sunray's own catalytic cracking refinery operations. The total crude oil throughput from the combined adjacent plants is approximately 30,000 barrels daily.

Still on Drawing Board— Durban Capacity Increased

With preliminary grading of the site yet to get under way, Standard-Vacuum Oil Company has announced plans to increase the capacity of its Durban, South Africa, refinery to 15,600 barrels of crude per day. The plant will now involve an investment of more than $17 million. A combination-type unit, it will combine Fluid catalytic cracking with crude distillation and thermal reforming functions. Foster Wheeler Corporation, construction engineers, has a team in the vicinity checking into materials, facilities, labor, and other problems.

Pernis Expansion Brings Capacity to 100,000 BPD

First of its type to be built at a European refinery, a new 25,000 barrel fluid catalytic cracking unit, went on stream mid-September at N. V. de Bataafsche Petroleum Maatschappij's Royal Dutch-Shell refinery at Pernis, Netherlands. The unit which was two years in the building, brings the major part of the expansion and rehabilitation program to a close. The refinery itself now has an approximate capacity of 100,000 barrels per day and reportedly ranks as the largest refinery in continental Europe. The Royal Dutch Shell group now has a European refining capacity of about 400,000 barrels daily.

Magnolia Plans Joint Gas Plant in Spraberry Area

Magnolia Petroleum Company has disclosed tentative plans for a jointly owned gasoline plant to be erected in the Spraberry Trend area to take care of the gas produced in the general area of the Midland, Upton, Reagan and Glasscock counties juncture. Other operators interested in the project are Sinclair, Atlantic, Sunray, Stanolind, Tide Water Associated, Sohio and Sun Oil Companies. If undertaken, Magnolia will construct and operate the plant.

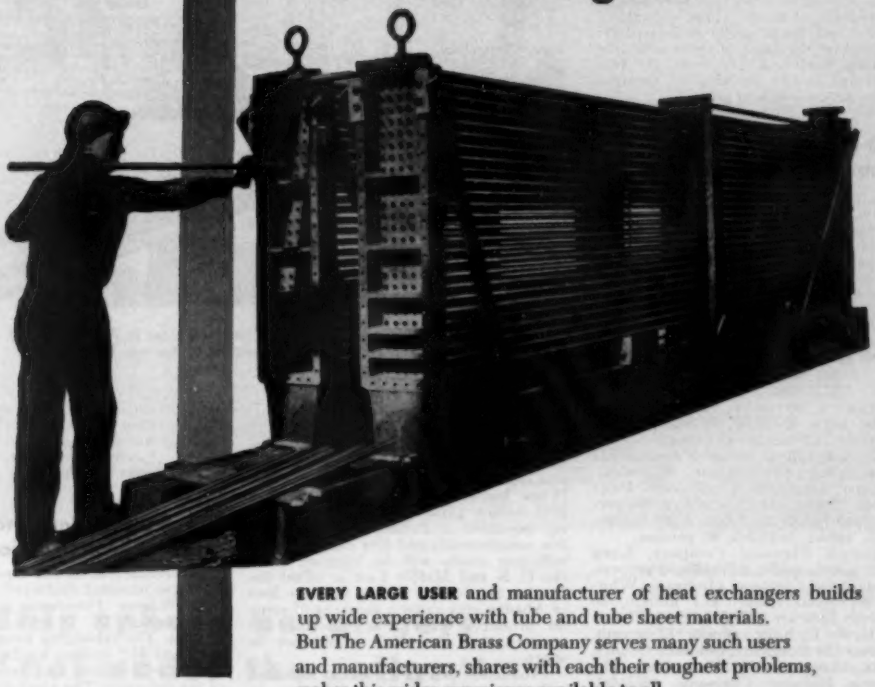
Stanolind Research Center Being Built at Tulsa

Authorization for a new research center to be built by Stanolind Oil and Gas Company at Tulsa has been granted by the Petroleum Administration for Defense, and work on the project will begin immediately. Manhattan Construction Company is contractor for the building which will probably be completed in April, 1953. The building will be devoted almost entirely to research in petroleum exploration and production, and to processes for making synthetic fuels and chemicals.

Elk Hills Gasoline Plant Proposed by U. S. Navy

A Navy request for $11.8 million to develop Naval petroleum reserves during the current fiscal year has been approved by the House Appropriations Committee. The request includes the construction of a $4 million natural gasoline plant at Elk Hills, Calif., which was provided for in the Defense Department's appropriations bill for fiscal year ending next June 30. The committee also endorsed construction of $1.5 million worth of necessary gathering lines

What technical service can Anaconda give you on Heat Exchangers?



ANACONDA Arsenical Admiralty Tubes being installed in tube bundle at Lemont, Illinois plant of Globe Oil & Refining Co. Fortified against dezincification by the arsenic content, tubes of this ANACONDA Alloy are being used with good results in many types of petroleum refining and other process equipment.

EVERY LARGE USER and manufacturer of heat exchangers builds up wide experience with tube and tube sheet materials. But The American Brass Company serves many such users and manufacturers, shares with each their toughest problems, makes this wider experience available to all.

Special laboratory facilities are maintained for this work. Detailed records of problems, conditions, findings are accumulated. These data, plus the results of continuous laboratory and field tests, are used to solve new problems.

These facilities can help produce the answers to your questions—suggest materials that will give your heat exchangers more dependability, longer life, more value under specific conditions.

We hope you will work with us—let us work with you. Write for Publication B-2, "ANACONDA Tubes and Plates for Condensers and Heat Exchangers." Please address The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

For efficient heat transfer ANACONDA® HEAT EXCHANGER TUBES

and the drilling of 101 new wells at a cost of $5.15 million.

The plant and gathering lines project at Elk Hills are urged by the Defense Department on the ground that facilities must be available to handle the natural gas made available from the Stevens Zone to avoid a serious waste of gas and other important products. It is estimated that the value of natural gasoline and by-products processed by the plant on the basis of full production of 30,000 barrels a day from the Stevens zone would amount to approximately $2 million a year.

PAD Lifts Moratorium Imposed on Construction

Projects granted rapid tax amortization in September were described as being representative of "facilities urgently needed for the expansion of critical raw materials" by the Defense Production Administration. The following refining and related projects were certified during the past month:

Sid Richardson Carbon Company, Odessa, Texas, elemental sulfur, $130,830, 80 percent. Phillips Chemical Company, Ector County, Texas, elemental sulfur, $1,741,000, 80 percent. Shell Chemical Corporation, Houston, elemental sulfur, $500,000, 80 percent.

Phillips Chemical Company, Texas Gulf Coast, anhydrous ammonia, methanol, acetylene, $38.3 million, 50 percent. Jefferson Chemical Company, Port Neches, Texas, ethylene glycol, 60 percent. Gulf Oil Corporation, Port Arthur, Texas, sulfur, $586,390, 80 percent.

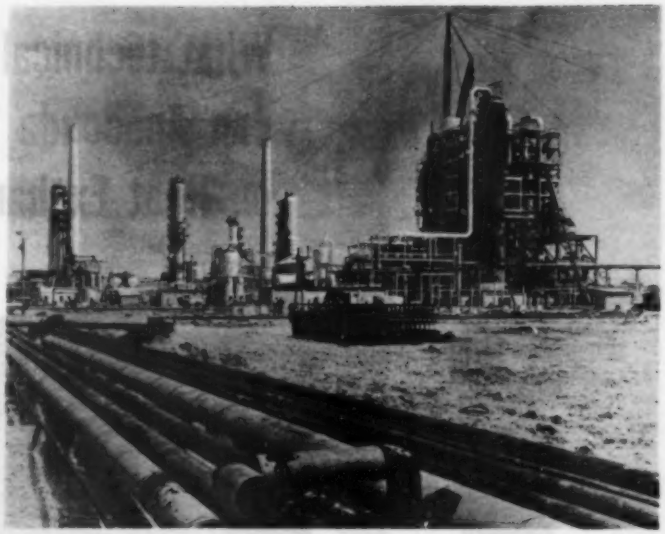
Hancock Chemical Company, Long Beach, Calif., sulfur, $250,000, 80 percent. Standard Oil Company (Indiana), Whiting, elemental sulfur, $1.7 million, 80 percent. Frontier Oil Company, Tonawanda, N. Y., basic refining, 70 percent. Superior Oil Company, Colorado County, Texas, basic refining, 70 percent. The Atlantic Refining Company, Philadelphia, anhydrous ammonia, $3.4 million, 50 percent. Lion Oil Company, New Orleans, anhydrous ammonia, $30.4 million, 50 percent.

If all applications on file with PAD were to be approved, and if materials could be obtained, industry has requested certification of enough projects to boost expansion of basic refining capacity to around 1.4 million barrels daily, or 400,000 barrels beyond the present expansion goal.

At present, PAD officials are asking defense agencies to increase the capacity goal set at 1 million barrels.

Burmah Oil and Burmese Government Form Company

Decision by Britain to loan Burma $7 million towards financing the Burmese share in the Burmah Oil Company project to produce and refine Burmese oil has been handed down to Thakin Nu, Premier of Burma. The loan is conditional on "mutually satisfactory arrangements in other respects." The new project is a joint venture between the British company and the Burmese government, to form a local company in which the government will hold one-third interest.



Europe's largest oil refinery, Esso Petroleum Company's plant at Fawley, England, shown above, was officially opened last month. See item below.

Early Opening of Fawley Offsets Loss of Abadan

The huge 110,000-barrel-per-day Esso Petroleum Company refinery at Fawley was officially opened last month by Prime Minister Clement R. Attlee. The $105 million plant is capable of supplying one-third of Britain's present gasoline requirements and it is expected that sufficient crude will be supplied from the U. S. and Middle East to offset the Iranian shut-down. Attlee said the loss of Abadan may cause a shortage of some oil products other than gasoline but stressed that the pinch would not be sharp.

Production at Fawley and at six other refineries now under construction in Britain will bring Britain's total refining capacity to about six times what it was in 1948.

Special process units in the Fawley plant include polymerization, sulfur dioxide extraction, fluid catalytic cracking and related units.

Deep Rock Awards Cushing Cooling Tower Contract

The Refinery Engineering Company of Tulsa has been awarded contract with Deep Rock Oil Corporation for site preparation and installation of various auxiliary equipment in connection with a lube oil expansion program at Cushing, Okla. A 3500 gallon-per-minute cooling tower with pumps, etc., is included. Engineering will proceed immediately with field construction to follow shortly thereafter.

Shell Chemical Schedules Expansion at Houston

Further expansion at Shell Chemical Company's Houston plant will raise the production capacity of ethyl chloride to "nearly double" existing capacity. Scheduled to begin in the immediate future, construction will probably be completed early in 1953. The additional capacity will increase the supply of tetraethyl lead for gasoline antiknock compounds and ethyl cellulose. The Armed Forces classifies ethyl cellulose as a "strategic plastic."

Fire Gutted Terminal Under Reconstruction

Reconstruction of the liquefied petroleum gas terminal destroyed by fire July 7 at Warren Petroleum Corporation's Port Newark, N. J., refinery will begin at once. The rebuilding program is estimated at $1.5 million by James E. Allison, vice president and general counsel of the company. The plant is expected to be back in operation before the end of the year.

Rochester Gas Plant Gets Koppers-Hasche Process

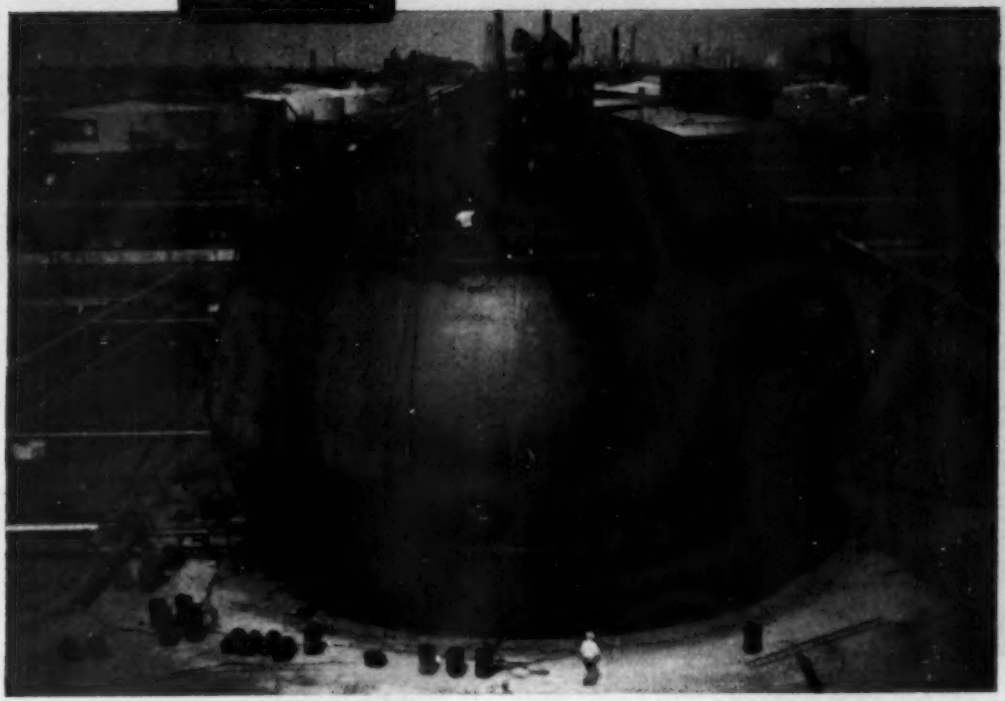
A low-cost gas producing plant, "so versatile that it can make city gas ranging in heat content from 300 Btu. to 1050," has gone into production at Rochester Gas & Electric Corporation's East plant. A demonstration unit, it is designed to produce over one million cubic feet of city gas daily, and can use gasoline, propane, butane, light oil or natural gas as raw materials.

Built by Engineering and Construction Division of Koppers Company, Inc., the plant process, patented by Koppers and discovered by Dr. R. Leonard Hasche, is known as the Koppers-Hasche process. It is based on either thermal or catalytic reforming.

Koppers Offers India Synthetic Gasoline Plants

India has reportedly accepted the broad principles of a plan to build two synthetic gasoline plants which was submitted to parliament by the Koppers

ANOTHER **ERKOTE** APPLICATION OF MASTIC COATING



This sphere never gets "hot under the collar"

Butane storage tanks such as this 40,000 barrel capacity Hortonsphere have to maintain low inside temperatures under complete weather cycling or the contents will vaporize.

A single ½" coating of ERKOTE 3X Insulating Mastic reduces heat transfer and provides a permanent protective surface for this unusual structure.

ERKOTE 3X is readily applied by spray and adheres to almost any type of surface. It requires no mechanical means to hold it in place regardless of surface angle; it sheds water, and it is extremely resistant to chemicals and corrosive fumes.

ERKOTE Technical Coatings—both Mastics and Paints—are used by many industries such as utilities, textiles, chemicals, railroads, paper mills and oil refineries for weather proofing, insulating and protecting against corrosion.

We offer you impartial advice on your problems

Since we manufacture both mastics and paints for industrial protection we can supply the exact surface coating to satisfy your requirements. Our engineers will be glad to help you with our recommendations.

ERKOTE Products . . . your assurance of *undivided* responsibility

Because we develop and produce our own mastics and paints and furnish our own trained crews to apply and maintain ERKOTE products with our own special equipment we assume *full responsibility* for the quality of the materials and the workmanship.

Would you like to know more about ERKOTE Technical Coatings? We will be glad to send you a booklet describing the many uses for our products.

ERKOTE TECHNICAL COATINGS

FOR USE WHERE PAINTS FAIL

EARL PAINT CORPORATION
240 Genesee Street
UTICA, NEW YORK

ERKOTE PRODUCTS

Corrosion Resisting Mastics, Mica Mastics, Insulating Mastics, Vapor Seals, Troweling Mastics, Color Finishers, Industrial Paints and Varnishes.

Company of America. Under Koppers plan one gasoline plant will produce 70,000 tons of aviation gas; 28,000 tons of motor gas; 1800 tons of refined phenol and 500,000 tons of domestic coke a year. The larger plant will produce 100,000 tons of aviation gas; 85,000 tons of motor gas; 3600 tons of refined phenol and 1 million tons of domestic coke yearly.

30,000 BPD Antwerp Plant On Stream This Month

All process units at the 30,000 barrel-per-day refinery operated by Societe Industrielle Belge des Petroles at Antwerp, Belgium, have been completed. In anticipation that the plant would go on stream this month the crude receiving tanks were filled even before the steam and power units were finished. In addition to the 30,000-barrel crude distilllation unit, the plant has a thermal cracking unit consisting of vis-breaking and cracking, reforming unit, and treating facilities. The plant will manufacture motor gasoline, kerosine, gas oil, and light and heavy fuel oils. Societe Industrielle is an Anglo-Iranian affiliate.

Czech Firm Negotiating Refineries In Bulgaria

Direct reports from behind the Iron Curtain claim that the Czechoslovakian Skoda Works are negotiating with the government of Bulgaria for the right to construct a 9400 barrel-per-day refinery at Varna, and a 15,000 barrel plant at Burgas. Both refineries would contain reforming units and construction at each factory would be supervised by Russian military personnel.

Construction Underway On Destrehan Coker

The Lummus Company will begin construction this month on a 9000 barrel-a-day coker for Pan-Am Southern Corporation's Destrehan, La., refinery. The 240 foot coker will be the second coking unit erected by the company; the other unit is in operation at its El Dorado, Ark., plant. The unit will process either heavy crude oil or heavy bottoms from the adjacent refinery unit and will add to operational flexibility.

Humble Soon to Complete Two Sulfuric Acid Plants

Two new plants for processing sulfuric acid will be in operation at its Baytown refinery by November, Humble Oil & Refining Company announced last month. Now under construction, these units will be headquarters for the processing of sulphuric acid to be re-used in the refinery. Instead of cooling acid in open coolers like those at the two old plants, the new plant will cool it in closed heat exchangers. Working conditions will be greatly improved. Both plants will have low maintenance cost because of the modern equipment and structural design.

Newest large installation at Baytown is pipe still No. 5, which replaces two old, less efficient units. It required a year to build and has a capacity of 70,000 barrels of crude a day. Total pipe still capacity at the refinery, including three other working units, is in excess of 220,000 barrels daily.

Largest Stripper on Stream At Richmond, California

Standard Oil Company of California is processing 55,000 barrels daily of fuel oil in the world's largest residuum stripper, which went on stream this quarter at Richmond, Calif. F. G. Follis, company chairman, described this project as a step toward cutting down overproduction of heavy fuel oils and increasing production of gasoline at the Richmond refinery.

Esso Standard Reveals Expansion at Baton Rouge

A capacity increase from 240,000 to 270,000 barrels of oil daily has been announced for Esso Standard Oil Company's Baton Rouge, La., refinery. The $35 million expansion will also include a major expansion of chemical operations according to general manager H. J. Voorhies. Work will begin immediately on the project which is expected to be completed within two years.

Richfield Adds 6000 BPD Cracking Unit at Watson

Expansion and improvement currently underway at Richfield Oil Corporation's Watson, Calif., refinery is being handled by C. F. Braun & Company. A 6000 barrel-a-day catalytic cracking unit is being added to the 100,000 barrel refinery and comprises the major process unit addition.

Koppers Buys Continental Blending Unit at Oil City

Koppers Company has purchased property adjacent to the Koppers petrochemical plant at Oil City, Pa., with a view toward ultimate expansion although no construction is contemplated at present. The plant on the purchased property formerly was used by Continental Refinnig Company for mixing oils and warehousing. Continental will transfer its blending activities to Philadelphia and New York.

Saskatchewan Refinery Processing 6000 BPD Crude

In Regina, Saskatchewan, the refinery operated by Saskatchewan Federated Co-operatives, Ltd., is now processing an average of 6000 barrels per day of crude to compare with the 500 barrel capacity of its initial run in 1934. New units recently installed more than doubled existing capacity.

Stanolind's Research Unit Near Tulsa Authorized

Field work on a research center near Tulsa will get underway immediately since authorization for construction has been given Stanolind Oil & Gas Company by the Petroleum Administration of Defense. Manhattan Construction Company will start construction this fall, and officials said work would take about 18 months.

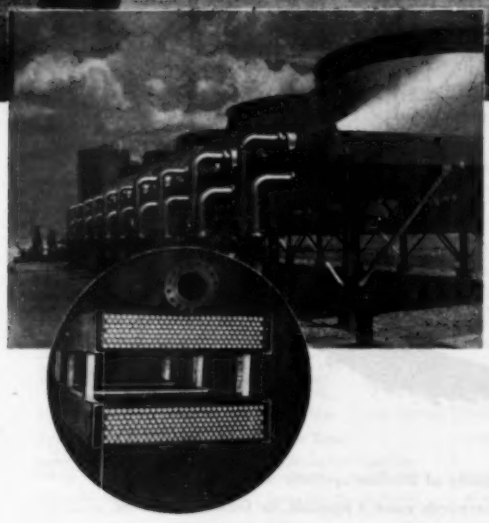
Seek Ammonia-Plant Site

Lion Oil Company whose headquarters are in El Dorado, Ark., is considering Charlotte, N. C., as the site for a $30 million anhydrous ammonia plant. Further plans are undisclosed.

REFINERY AND OTHER PLANT CONSTRUCTION

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
EAST									
Allied Chemical	Hopewell, Va.	Synthetic Nitrogen	†50,000 tons yr.	$12.5 million					
*Allied Chem. & Dye	N. Claymont, Del.	Chem. plt.		$2.5 million	Under Constr.	1953			
Ashland Oil & Refining	Buffalo, N.Y.	Crude Unit Exp.	15,000 bbls.		Under Constr.	1951			Cat. Constr.
Atlantic Refining Co.	Philadelphia, Pa.	Detergent Mfg. Facilities		$1.5 million	Under Constr.	1951			
Atlantic Refining Co.	Philadelphia, Pa.	Catalytic Reforming Unit	11,000 bbls.	$4 million	Under Constr.	Mid 1952	Atlantic	Badger	Badger
Atlantic Refining	Philadelphia, Pa.	Two stage pipe still. Cat; Alky; Poly Units	50,000 bbl.	$5.6 million					
*California Refining	Barber, N. J.	Expansion	47,000 bbls.		Under Constr.	1952			
California Refining	Perth Amboy, N. J.	Alkylation units	2,240 bbls.	$3.6 million	Completed				
California Refining	Perth Amboy	Gas-Fuel Oil Additions		$33 million	Completed				
Cambridge Gas Light Co.	Cambridge, Mass.	Light Oil Recov.	21 Mmcf		Contracted	1951		Blaw-Knox	Blaw-Knox
*Delta Refining	Memphis, Tenn.	Airlift Cat. Crk	3,000 bbls.	$1.8 million	Begin Jan., 1952	Late 1952	SoVac	Koch	Koch
*Delta Refining	Memphis, Tenn.	Cat. Poly.; gas Cone; crude Distillation revamp	†2,000 bbls.		Begin Jan., 1952	Late 1952		Koch	Koch

* Table continued on page 89



BULLETINS ON HUDSON TOP PERFORMANCE Cooling Towers and Air Cooled Exchangers mailed on request.

HUDSON
Top Performance
COOLING EQUIPMENT

COOLING TOWERS
AIR COOLED EXCHANGERS
ATMOSPHERIC SECTIONS

Undivided Responsibility—Complete integration in the selection and design of cooling equipment best suited to specific installations results in minimum first cost and minimum operating cost—and the responsibility is undivided.

HUDSON
ENGINEERING CORPORATION
FAIRVIEW STATION • HOUSTON, TEXAS

it's the results that count!

Top results are insured through the uniform quality of Davison synthetic fluid-type cracking catalysts. Years of experience and research make it possible for Davison to better control physical characteristics and maintain chemical purity of their catalysts. Your requirements can now be supplied in either microspheroidal (M-S*) or ground (DA-1*) form . . . both available in various average particle sizes.

The Davison "D" also stands for dependability. Likewise, you can depend on Davison facilities for the development and production of catalysts for your specific processes.

*T.M.T.D.C.C.

Progress Through Chemistry

THE DAVISON CHEMICAL CORPORATION

Baltimore 3, Maryland

PRODUCERS OF: CATALYSTS, INORGANIC ACIDS, PHOSPHATES, PHOSPHATE ROCK, SILICA GELS, SILICOFLUORIDES AND FERTILIZERS

REFINERY AND OTHER PLANT CONSTRUCTION—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
Dewey & Almy Chemical Co.	Cambridge, Mass.	Synthetic Rubber Addition	.....	$404,000	.....	.....	.....	.....	.....
*Du Pont	Deepwater Point, N. J.	Tetraethyl Lead Fac.	140,000 lbs.	$3.4 million	Under Constr.	1952	.....	.....	.....
*Esso Petroleum	Everett, Mass.	Expansion-crude	†9,500 bbls.	.....	Under Constr.	June, 1952	.....	.....	Foster Wheeler
Esso Standard Oil Co.	Bayway, N.J.	2 Desalt. Units	50,000 each	.....	Under Constr.	1951	Howe-Baker	Fluor	Fluor
Esso	Everett, Mass.	Fluid Cat. Crk.	†18,500 bbl.	.....	.....	Early 1953	.....	SOD	Foster Wheeler
Esso	Everett	Rerun pipe still	†7,000 bbl.	.....	Under Constr.	1952	.....	SOD	.....
Gulf Oil	Harmarville, Pa.	Research Lab.	.....	$1.1 million	Under Constr.	June, 1952	.....	.....	.....
Gulf	Philadelphia, Pa.	Expansion	183,000 bbl.	$40.6 million	.....	.....	.....	.....	.....
Gulf	Philadelphia	Crude Topping Unit	†76,000 bbl.	.....	.....	.....	.....	.....	.....
Gulf	Philadelphia	Cat. Cracker	†8,930 bbl.	.....	.....	.....	.....	.....	.....
Gulf	Pittsburg, Pa.	Ethylene Plt.	.....	$15.4 million	.....	.....	.....	.....	.....
Kendall Refining	Bradford, Pa.	Cat. Reformer	1,500 bbl.	$913,671	.....	.....	.....	.....	.....
Koppers	Kobuta, Pa.	Styrene Monomer	.....	$4 million	Design	.....	.....	.....	.....
*Lion Oil	Charlotte, N.C.	Anaydrous Ammonia Plt.	.....	$30 million	Considering	1953	.....	.....	.....
Louisville Refining Co.	Louisville, Ky.	Cat. Cracker	3,000 bbls.	$2 million	Under Constr.	1951	.....	U.O.P.	.....
Mathieson Hydrocarbon Chemical Corp.	Brandenburg, Ky.	Chemical Plt.	.....	$17 million	Under Constr.	End 1951	.....	Badger, Stone & Webster	Badger, Stone & Webster
Mathieson	Doe Run, Ky.	Isobutane Facilities	5,000 bbl.	$19 million	Under Constr.	.....	.....	.....	.....
M. F. A. Oil	Memphis, Tenn.	Cat. Crk. & Aux.	2,300 bbl.	$1.7 million	Engineering Plan	.....	.....	.....	.....
Monsanto Chemical	Addyston, Ohio	Styrene Plastics Plt.	.....	.....	.....	.....	.....	.....	.....
Monsanto	Charleston, W. Va.	Enlarg. Chem. Facilities	.....	$9 million	Engineering	Spring, 1952	.....	.....	.....
New Bedford Gas & Edison Light Co.	New Bedford, Mass.	Light Oil Recov.	24 Mmcf	.....	Under Constr.	1951	.....	Blaw-Knox	Blaw-Knox
New York State Natural Gas Corp.	Boom Sta., Lawrenceville, Pa.	Nat'l.-Gas Dehydration Plt.	200,000 mcf	$250,000	Under Constr	1951	.....	Blaw-Knox	Staff
Socony-Vacuum	Buffalo, N. Y.	Cat. Cracker	4,500 bbl.	$4.6 million	Engineering	.....	.....	.....	.....
Socony-Vacuum	Buffalo	Cat. Poly.	6'2 bbls.	.....	.....	.....	.....	.....	.....
Socony-Vacuum	Paulsboro, N.J.	Crude Unit	46,000 bbl.	.....	Under Constr.	3rd Qtr. 1952	.....	Socony-Braun	Braun
Standard Oil Devel.	Baltimore, Md.	Still Replacement	.....	$110,000	Under Constr.	End 1951	.....	.....	Day & Zimmerman
Standard Oil-Calif.	Richmond, Va.	Vacuum Flasher	55,000 bbl.	.....	Under Constr.	End 1951	.....	Kellogg	Kellogg
Standard Oil-Calif.	Richmond	Modernization	.....	.....	Under Constr.	End 1951	.....	Kellogg	Kellogg
Sun Oil	Marcus Hook, Pa.	Benzene & Toluene Plt.	550/1000 bbl.	$8.4 million	Under Constr.	.....	Sun	.....	.....
Sun Oil	Marcus Hook	Houdriforming Process	13,000 bbl.	$3 million	Under Constr.	Fall, 1952	Houdry	.....	.....
Sun Oil	Marcus Hook	Avgas	850 bbl.	$2.6 million	Under Constr.	.....	.....	.....	.....
*Sun Oil	Marcus Hook, Pa.	Ammonia (Refg.) Unit	†1,000 bbls.	.....	Under Constr.	.....	.....	.....	.....
*Sun Oil	Marcus Hook, Pa.	Lube Oil Plt.	8,400 bbls.	.....	Under Constr.	.....	.....	.....	.....
*Sun Oil	Marcus Hook, Pa.	Propylene Poly. Unit	6,000 bbls.	.....	Under Constr.	.....	.....	.....	.....
Tennessee Gas Transmission Co.	Greensburg, Ky.	Stripping Plt.	750,000 mcf gas	$12 million	Completed	1951	.....	Stone & Webster	Stone & Webster
Union Oil Co.	Edmonds, Va.	Asphalt Refinery	65,000 tons	.....	Under Constr.	1951	.....	.....	Bechtel
United Refining Co.	Warren, Pa.	Lab.	.....	.....	Under Constr.	1951	.....	.....	.....
U. S. Industrial Chemical	Baltimore, Md.	Ethyl Alcohol Plt.	.....	$328,815	Announced	.....	.....	.....	.....
MID-CONTINENT									
Advance Refining	Centralia, Ill.	Perco Cat. Crk.	660 bbl.	.....	Under Constr.	Oct., 1951	Phillips	Grebe & Doremus	Grebe & Doremus
Allied Chemical & Dye Corp.	South Point, O.	Synthetic Nitrogen	50,000 tons yr.	$12.5 million	Design	.....	.....	.....	.....
American Cyanamid	Michigan City, Ind.	Synthetic Cat. Prod.	To 400 tons	$5 million	Completed	June, 1952	.....	Blaw-Knox	Blaw-Knox
Ashland O&R	Canton, Ohio	Gas, Jet. Fuel, Butane	.....	$3.8 million	Under Constr.	Fall, 1951	.....	.....	.....
Ashland O&R	St. Elmo, Ill.	Gasoline & Kerosine	.....	$665,000	Under Constr.	.....	.....	.....	.....
Ashland Oil & Ref.	Canton, Ohio	Fluid Cat. Crk.	8,000 bbls.	$4 million	Under Constr.	.....	U.O.P.	U.O.P.	McKee
Ashland	Canton	Gas Conc. Unit	.....	.....	Under Constr.	.....	U.O.P.	U.O.P.	McKee
Ashland	Canton	Cat. Poly Unit	1,800 bbls.	.....	Under Constr.	.....	U.O.P.	U.O.P.	McKee
Ashland	Canton	Add. Crude & Treating tankage	20,000 bbls.	.....	Under Constr. Under Constr.	.....	.....	U.O.P. U.O.P.	McKee McKee
Ashland Oil & Refining	Wood River, Ill.	Topping; Crk.	5,000 1,200 bbl.	$665,000	Under Constr.	.....	.....	.....	.....
Aurora Gasoline & Keystone Oil	Detroit, Mich.	Refinery Expan.	.....	$4 million	Announced	.....	.....	.....	.....
Aurora Gasoline Co.	Detroit, Mich.	Platforming Unit	4,500 bbls.	.....	Under Constr.	End, 1951	U.O.P.	U.O.P.	U.O.P.
Bell Oil & Gas	Granfield, Okla.	Platformer	1,500 bbl.	$290,322	Completed	.....	U.O.P.	U.O.P.	Staff
Bureau of Mines	Otis, Kans.	Reopen Heli. Plt.	48 Mcf/yr.	*$3 million	Under Constr.	.....	.....	.....	*Original Cost
Cities Service Oil Co.	Chicago, Ill.	Grease-Making Fac.	8.5 million lbs.	.....	Planned	End 1951	.....	.....	.....
*Cities Service	E. Chicago, Ind.	Fluid Hydroformer	10,000 bbls.	.....	Design	Late, 1952	.....	Kellogg	Kellogg
*Cities Service	Cushing, Okla.	Cat. Cracker	10,000 bbls.	.....	Under Constr.	Mid 1951	.....	.....	.....
Cities Sv. Oil-Del.	Ponca City, Okla.	Fluid Cat. Crk.	8,350 bbl.	$6.5 million	Under Constr.	Jan., 1952	.....	Kellogg	Kellogg
Cities Sv.-Del.	Ponca City	Crude Vacuum	21,000 bbl.	.....	.....	.....	.....	.....	.....
Columbian Carbon	El Dorado, Ark.	Carbon Blk. Plt.	800 bbl.	.....	Under Constr.	Sept., 1951	.....	.....	Ford-Bacon-Davis
Columbian Carbon Co.	El Dorado, Ark.	Carbon Black Plt.	98,630 lbs.	$1.5 million	Completed	.....	.....	.....	.....
Continental Oil Co.	Ponca City, Okla.	Res. Lab. Bldg.	.....	$2.3 million	Under Constr.	Fall 1951	.....	Wigton-Abbott	Wigton-Abbott
*Deep Rock Oil	Cushing, Okla.	Blend & Pkg. Plt.	17,000 gallons	.....	Under Constr.	Dec., 1951	.....	Blaw-Knox	Blaw-Knox
Derby Oil Co.	Wichita, Kans.	TCC Cat. Poly Gas Concent.	.....	$2 million	Under Constr.	4th Qtr., 1952	Socony-U.O.P.	Fluor	Fluor
Dewese Oil Co.	Weston, Ohio	Lube Filtering	250 bbls.	$15,000	Under Constr.	1951	.....	Staff	Staff
Dow Chemical	Midland, Mich.	2nd Hypersorption Unit	.....	.....	Under Constr.	.....	Union Oil (Calif.)	Foster Wheeler	Foster Wheeler
Dow Chemical	Ludington, Mich.	Bromine for TEL	2 million lbs. yr.	$433,500	Under Constr.	.....	.....	.....	.....
Dow Chemical	Midland, Mich.	Ethylene Dibromide	.....	$370,000	Under Constr.	.....	.....	.....	.....

REFINERY AND OTHER PLANT CONSTRUCTION—*Continued*

COMPANY	Plant Size	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
Dow Chemical	Midland	Vinyltoluene Plt.		$8 million	Constr. Fall	July, 1952		Stone & Webster	Stone & Webster
Dow-Corning	Midland, Mich.	Methyl Chloride		$820,000	Design				
Great Northern	St. Paul, Minn.	Crude Topping	30,000 bbls.						
Great Northern Oil	St. Paul	Cat. Crk.	7,620 bbls.	$22.6 million	Under Constr.				
Great Northern	St. Paul	Cat. Reformer	6,000 bbls.						
Great Northern	St. Paul	Cat. Poly.	680 bbls.						
Hugoton Plains Gas & Oil Co.	Hooker, Okla.	Nat. Gasoline Stripping Plt.	2,380 bbls. Nat. Gas Prod.		Under Constr.	1951			
Indiana Farm Bureau Cooperative Assn.	Mt. Vernon, Ind.	Fluid Cat. Crk.	4,000 bbls.		Under Constr.	1951		U.O.P.	Staff
Indiana Farm Bureau	Mt. Vernon	Gas Concen.	2,500 bbls.		Under Constr.	1951			U.O.P.
Indiana Farm Bureau	Mt. Vernon	Vacuum Unit	300 bbls.		Under Constr.	1951			U.O.P.
*International Refineries	Carlton City, Minn.	Refinery	11,500 bbls.	$7 million	Under Constr.	Oct., 1952	S.O.D.	Lummus	Lummus
Johnson Oil Ref. Co.	Cleveland, Okla.	Platforming	1,500 bbls.	$780,000	Under Constr.	1951		U.O.P.	Procon, Inc.
Kanotex Refining	Arkansas City, Kans.	Fluid Cat	4,600 bbl.	$2.4 million	Under Constr.	June, 1952	U.O.P.	U.O.P.-Ref.Eng.	Ref. Eng.
Kanotex	Arkansas City	Vacuum Unit	5,700 bbl.						
Lakeside Refining	Kalamazoo, Mich.	Cat. Reformer			Contracted	Dec., 1951	Phillips	Koch	Staff
Lion Oil	El Dorado, Kans.	Av-Gas Expan.	432 bbl.	$810,000	Under Constr.				
Lion Oil	Magnolia, Ark.	Sulfur Recovery	10 tons		Under Constr.	Sept., 1951		Graff	Graff
Mercury Oil Refining	Oklahoma City	Cat. Crk.; Poly.	2,500/360 bbl.	$3.2 million	Design				
Mercury	Oklahoma City	Topping; Thermal	5,900/1,800 bbl.						
Midwest Refineries	Alma, Mich.	Cat. Reform.; Topping	1,500/6,300 bbl.	$933,700	Design				
Midland Co-Op. Wholesale Co.	McPherson, Kans.	Expansion	122,000 bbls.	$4 million	Under Constr.				
*Minnesota Mining	Copley Twp., Ohio	Sulfuric Acid Fac.		$2.1 million	Under Constr.				
Mississippi River Fuel Co.	Fredericktown, Mo.	Comp. Sta.	4,000 hp.		Under Constr.	1951		Ref. Maint.	Ref. Maint.
National Co-Op. Refinery Assn.	McPherson, Kans.	Polymerization, Fld Cat. Crk., Add tnkge, Util.	122,000 bbls.	$2 million	Under Constr.		U.O.P.	Ref. Eng.	Ref. Eng
Northern Nat. Gas.	Holcomb, Kans.	Gas Ddhydration Plt. Addi.			Under Constr.	Jan., 1952		Dresser	Dresser
Northern Nat. Gas.	Holcomb	Gas Refg. Plt.	185,000 Mcfd		Under Constr.	Jan., 1952		Dresser	Dresser
Northern	Sublette, Kans.	Gas Dehyd. Addition			Under Constr.	Nov., 1951		Dresser	Dresser
Northwestern Refining	St. Paul Park, Minn.	Topping & Cracking Unit	30,000 bbl.	$2 million	Preparing	Aug., 1953			
Ohio Standard	Cleveland, O.	Crude Topping	7,000 bbl.	$4.2 million	Design				
Ohio Standard	Cleveland	Cracker; Poly	18,000/40 bbl.						
*Ohio Oil	Robinson, Ill.	Expansion	110,000 bbls.		Supply	Early 1953			
Oklahoma Refg. Co.	Seminole, Okla.	Refinery	200 bbls.	$40,000					
Old Dutch Refining	Muskegon, Mich.	Aromatic Fac.	150 B 370 T.	$515,130	Under Constr.				
*Pana Refining	Pana, Ill.	Polymerization Unit	75 bbls.	$150,000	Completed		U.O.P.	U.O.P.	U.O.P. & J. S.
*Pana Refining	Pana, Ill.	Girbotol Unit			Under Constr.				Parker
Peppers Refining	Oklahoma City	Revamp Units			Under Constr.		Phillips-U.O.P.		Staff
Petroleum Specialties	Flat Rock, Mich.	Cat. Cracker	3,000 bbls.	$1 million	Planning				
Phillips Petroleum Co.	Okmulgee, Okla.	Cat. Crk. with Feed Prep. Unit & Gas Plt.			Under Constr.	May, 1952			
Petroleum Spec.	Flat Rock, Mich.	Cat. Reformer	900 bbl.	$700,000	Under Constr.				
Phillips Petroleum	Okmulgee, Okla.	Cat. Crk.; Others	1800 bbl.		Under Constr.	May, 1952		Fluor	Fluor
Pure Oil	Smith's Bluffs, Ark.	Alkylate Fac.		$300,000	Under Constr.				
Pure Oil	Toledo, Ohio	Cat Cracker		$7 million	Plan				
Roosevelt Oil & Refining	Mt. Pleasant, Mich.	Benzene Plt.		$1.5 million					
Shell Oil Co.	Elk City, Okla.	Gas Extrct Plt.	100,000 mcf gas		Under Constr.	1951		Ref. Maint.	Ref. Maint.
Shell Oil Co.	Mogadore, Ohio	Marketing Terminal		$160,000	Under Constr.	1951			Poling & Bacon
Shell Oil	Wood River, Ill.	Aromatics	255 bbl.	$150,000	Under Constr.				
Shell Oil Co.	Wood River, Ill.	Platforming Unit	15,000 bbls.		Under Constr.	Oct., 1951	U.O.P.	U.O.P.	Procon
*Skelly Oil	Velma, Okla.	Gas Plt. Expan.	73 mil. cu. ft.		Under Constr.	Nov., 1951			
*Skelly Oil	Velma, Okla.	Booster Station			Planned				
Sinclair Refining	E. Chicago, Ind.	Refinery Expan.	20,000 bbl.		Under Constr.	Jan., 1952		McKee	McKee
Socony-Vacuum	E. Chicago, Ind.	Houdry to TCC	15,000 bbls.		Under Constr.	Aug., 1951	Socony-Vacuum	Socony-Braun	Braun
Socony-Vacuum	E. St. Louis, Ill.	Alky. Unit Rehab.	775 bbl.	$280,000	Design				
Standard-Ind.	Neodesha, Kans.	Cat. Crk.; Alky. Unit	9,300 bbl.	$10 million	Under Constr.	End 1952			
Standard-Ind.	Sugar Creek, Mo.	Crude Expan.	120,000 bbl.	$21 million	Preparing	End 1952			
Standard-Ind.	Sugar Creek	Olefin Concentrate		$142,000	Announced				
*Standard-Indiana	Whiting, Indiana	Sulfur Recovery Plt.	35 tons		Under Constr.	Middle 1952		Fluor	Fluor
Standard-Ind.	Whiting, Ind.	Av-Gas Components		$2.3 million	Under Constr.	End 1951			
Standard-Ind.	Wood River, Ill.	Alcohols Prod.	10 million lbs.	$2.6 million	Design	Mid 1952			
Standard Oil of N.D.	Grand Forks, N. Dakota.	Refinery	2,000-2,500 bbls.		Planning				
Standard (Ohio)	Lima, Ohio	Terminal Fac.		$2 million	Planning	1951			
Standard (Ohio)	Toledo, Ohio	Terminal Fac.			Planning	1951			
Standard (Ohio)	Columbus, Ohio	Terminal Fac.			Planning	1951			
Standard (Ohio)	Cleveland, Ohio	Crd. Dist. Plt.	45,000 bbls.	$6½ million	Under Constr.	Jan., 1952		McKee	McKee
Stanolind Oil & Gas Co.	Tulsa, Okla.	Research Center			Planning			Shreve, Lamb and Harmon Assoc.	
Stanolind Oil & Gas	Ulysses, Kans.	Gaso Plt. Exp.	200,000 mcf		Planning	1951			
Superior Refinery Owners, Inc.	Superior, Wis.	Topping Thermal Crk.; Poly.	6,000 bbl. 1000/24 bbl.	$1.2 million	Under Constr.				
*Sun Oil	Toledo, Ohio	Platform Unit	10,000 bbls.		Under Constr.		U.O.P.		
*Sun Oil	Toledo, Ohio	Propylene-Poly Unit	4,000 bbls.		Under Constr.				
*Sunray Oil	Sunray, Okla.	Refinery Rehab	10,000 bbls.	Leased	Completed			Staff	Staff
*Sunray Oil	Duncan, Okla.	Booster Station			Completed			Staff	Staff
Sunray Oil	Duncan, Okla.	Alkylation Fac.	2,100 bbl.	$1.7 million	Design				
Texas Co.	Lawrenceville, Ill.	Expand Refinery	120,000 bbls.		Under Constr.	1951		Foster Wheeler Kellogg	Foster Wheeler, Kellogg
Tide Water Assoc. Oil	Drumright, Okla.	Crude Topping; Vacuum	15,000 bbl. 6,000 bbl.		Design			Ref. Eng.	Ref. Eng.
Warren	Mayaville, Okla.	Plt. Additions			Under Constr.	Oct., 1951		Staff	Dresser
Western Oil & Fuel	Superior, Wis.	Topping, Cat. Cracker	10,000/3,000	$6 million	Under Constr.				

• Table continued on page 93

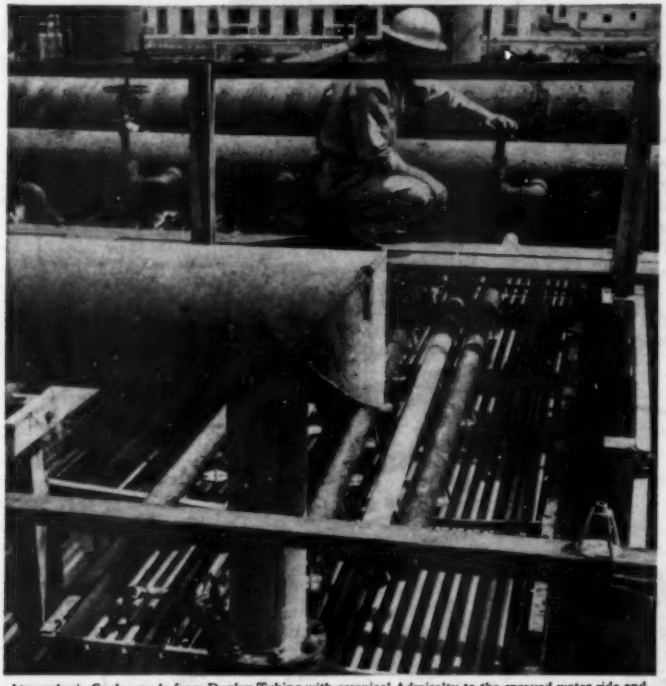
BRIDGEPORT BRASS COMPANY

CONDENSER AND HEAT EXCHANGER TUBE EDITION

COPPER ALLOY BULLETIN

"Bridgeport" BRASS CO. MILLS IN BRIDGEPORT, CONN. AND INDIANAPOLIS, IND. — IN CANADA: NORANDA COPPER AND BRASS LIMITED, MONTREAL

Duplex Tubing for Difficult Corrosion Problems



Atmospheric Cooler made from Duplex Tubing with arsenical Admiralty to the sprayed water side and stainless steel to the product side. Courtesy Celanese Corp. of America, Chemcel Plant, Bishop, Tex.

Frequently a relatively minor constituent may cause much more trouble than the medium itself. For example, pure water has practically no effect on stainless steel, yet water with a small amount of chlorides (a few parts per million) may lead to serious failures under certain conditions.

Atmospheric Cooler

An example of such failure occurred in an atmospheric cooler made from stainless steel tubing. Stress corrosion cracking took place on the outside of the tubing where it was subjected to a spray of fresh water containing a small amount of chlorides. The stainless steel stood up satisfactorily on the inside against acetic acid containing some formic acid.

Stress-corrosion cracking had developed from the water side and destroyed the usefulness of the tubing. However, by changing over to Duplex Tubing with arsenical Admiralty to the water side and stainless steel to the product side, the service life of the atmospheric cooler has been greatly increased. In addition, the heat transfer properties have also been substantially improved by the use of Duplex Tubing in its construction.

Stainless vs. Copper Alloys

The above illustrates the importance of studying the corrosion characteristics of each metal and applying the one best suited to withstand the particular corrosive media involved. It is recognized that in general, stainless steels are resistant to a large number of corrosive media. On the other hand, copper and its alloys possess excellent corrosion resistance to many gases, acids and salts and their water solutions. This explains their wide usage for handling cooling waters and other solutions that contain salts and gases.

Many users of stainless steel tubing have learned through experience what can and cannot be accomplished with stainless steel. Its fine performance in certain services has revealed that conservation of critical materials can often be achieved by using considerably thinner gauges.

Where one surface of the stainless steel tubing requires the corrosion resistance of copper and copper alloys towards cooling waters, brine, and certain chemicals, Duplex Tubing offers great possibilities.

Stainless steel is outstandingly superior to copper towards impingement corrosion by steam and other gases but may be subject to attack on the water side. Thin stainless steel tubes lined with copper or a copper alloy offer a solution to this type of corrosion problem. At the same time, the fine heat transfer characteristics of copper are imparted to this Duplex tube combination. This means that heat exchangers and condensers, designed around straight copper tubes, can be retubed with copper lined stainless steel Duplex Tubing without any over-all loss in heat transfer rate.

Along the same lines, low chrome steels and stainless steels have in certain types of vent condensers and gas coolers given good performance except where the alloy is vulnerable to either stress corrosion cracking or pitting in certain types of fresh and sea waters.

Under conditions of low water velocity these ferrous alloys are quite susceptible to fouling by certain types of marine organisms in sea water. Biofouling may contribute toward rapid corrosion pitting and may cause a marked reduction in heat transfer rate. The use of a lining of copper or certain copper alloys assures considerable freedom from biofouling. For additional information on applications of Duplex Tubing, write for Bridgeport "Duplex Tubing Technical Bulletin No. 1950". (7216)

Here's "on the job" proof of furnace savings with

B&W ALLMUL FIREBRICK

BILLET HEATING FURNACE

"ALLMUL cost half as much!"

A builder of billet heating furnaces used an expensive electrically-fused mullite refractory in the piers and baffles as well as for the arches in the discharge end of the flue. Reason? Severe operating conditions at these points. Tests of B&W Allmul proved it withstood high temperatures equally well . . . cost approximately half as much. Result? Allmul is now standard for these locations.

BUTT WELDING FURNACE

"39 weeks instead of 6 weeks!"

Semi-mullite brick bungs in the hottest part of a butt welding furnace spalled badly after six weeks. Allmul bungs in the same location were still going strong after *39 weeks*—in better condition than the semi-mullite bungs after six weeks. *Yet Allmul cost little more than the original semi-mullite refractory.* Allmul is now used in uptake arches, uptake side walls and crossovers. Customer has ordered 30 carloads to date.

CUPOLA FRONT-SLAGGER

"ALLMUL has 6 times the life plus . . ."

Replacing super-duty firebrick in a cupola front-slagger of a malleable duplexing operation three times a week was an expensive chore. B&W Allmul in the same location lasts approximately two weeks . . . *six times as long.* Costs drop, too, because of savings due to less frequent relining.

What's behind the remarkable, money-saving performance of B&W Allmul Firebrick? The answer lies in its low first cost for a fused mullite brick and unique combination of excellent refractory properties: high hot load strength, high resistance to spalling, good volume stability, a high melting point of 3335F. Bulletin R-29 gives all the facts on Allmul. Write for your copy.

BABCOCK & WILCOX

THE BABCOCK & WILCOX CO.
REFRACTORIES DIVISION
GENERAL OFFICES: 85 LIBERTY ST., NEW YORK 6, N.Y.
WORKS: AUGUSTA, GA.

R-429

B&W REFRACTORIES PRODUCTS—B&W Allmul Firebrick • B&W 80 Firebrick • B&W Junior Firebrick • B&W Insulating Firebrick • B&W Refractory Castables, Plastics and Mortars • OTHER B&W PRODUCTS—Stationary & Marine Boilers and Component Equipment... Chemical Recovery Units . . . Seamless & Welded Tubes . . . Pulverizers . . . Fuel Burning Equipment . . . Pressure Vessels . . . Alloy Castings

REFINERY AND OTHER PLANT CONSTRUCTION—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
Wilcox Oil	Fristow, Okla.	Cat. Reformer	1,500 bbl.	$1 million	Under Constr.	Aug., 1952	U.O.P.	Procon	Procon
Wood River Oil Refining	Gary, Ind.	Crude Topping, Crak.; Poly.	15,000 bbl. 6,000/600 bbl.	$1 million	Design				
SOUTHWEST									
Acadia Corp.	Shreveport, La.	Motor gas unit		$2.9 million	Design				
*Alamo Chemical	Houston, Texas	Anhydrous Ammonia Plt.		$38 million	Engineering				
American Petro-Chemical Corp.	Lake Charles, La.	Chem. Plt.			Planned				
Arizona Interests	Florence, Ariz.	Refinery	15,000 bbls.	$25 million	Planning	1952		Kbasco	
Arkansas-Louisiana Gas Co.	Blanchard, La.	4,200 hp Compressor Sta.	66,400 mcf		Under Constr.	1951		Staff	Delta
Aromatics Refining	Baton Rouge, La.	Aromatics Fac.		$11.6 million	Design				
Atlantic Refining Co.	Port Arthur, Texas	Detergent Mfg. Facilities		$1.5 million	Under Constr.				
Atlas Processing	Shreveport, La.	Extractive Distill.	17,000 gals.	$2.6 million	Under Constr.	Mar., 1952	U.O.P.	U.O.P.	Hudson
Atlas	Shreveport	Platforming Unit			Under Constr.	Mar., 1952	U.O.P.	S.O.D.	Procon
Atlas	Shreveport	Cat. Reformer	2,500 bbl.	$700,000	Under Constr.	Mar., 1952			
Barnsdall Oil Co., Op.	Scurry Co., Tex.	Nat. Gaso. Plt.	50,000 mcf gas	$6.5 million	Considering	1951			
Bay Petroleum Corp.	Chalmette, La.	Modernization of Cracking Fac.	6,000 bbls.		Under Constr.	End 1951	U.O.P.	U.O.P.	Procon, Inc.
Bay Petroleum	Chalmette, La.	Cat. Cracker	†6,000 bbl.	$1.7 million	Under Constr.	Nov., 1951	U.O.P.	U.O.P.	Procon
Bell Oil Corp.	Lake Charles, La.	Nat. Gas Plt.	12,000 Mcf		Completed			Grebe & Doremus	Grebe & Doremus
Cabot Carbon Co.	Bayou Sale, St. Mary Parish, La.	Thermal Black Plt.	136,986 lbs.	$4 million	Designing	1953			
Cabot Carbon Co.	Bayou Sale, St. Mary Parish, La.	Oil Furn. Carbon Blk. Plt.	82,192 lbs.		Designing	1953			
Carbide & Carbon Chemicals	Texas City, Tex.	Acetylene Plt.			Plan	July, 1952			
Celanese Corp.	Pampa, Tex.	Chem. Plt.		$3.5 million	Under Constr.	June, 1952		Brown & Root	Brown & Root
*Cities Service	Lake Charles, La.	Fluid Hydro-former	19,000 bbls.		Under Constr.			Kellogg	Kellogg
*Const Oil	Cotton Valley, La.	Refinery Rehab.	4,000 bbls.		Under Constr.				
Commercial Petroleum & Transport Co.	Cold Spring Field, San Jacinto, Texas	Compressor, Dehydration, Metering	15 M mcf	$235,000	Completed	1951		Chas. F Sandor-son	Pioneer
Consolidated Chemical, Ind.	Baton Rouge, La.	Sulfur Plt.	50 tons		Announced			Parsons	Parsons
Continental Oil	Westlake, La.	Furnace Black	67,000 lbs.	$2 million	Completed	Fall 1951			
Continental Oil	Lake Charles, La.	Refinery Expan.	40,000 bbl.	$24 million	Under Constr.	Late 1952		Badger-Conoco	Badger
Continental Oil Corp.	Lake Charles, La.	Expansion, Cat. Crk., add equip. for High Octane Production	40,000 bbls.	$34 million	Under Constr.	Late 1952		Badger	Badger
Conden Petroleum Corp.	Big Spring, Texas	Topping, Reforming, Aromatics Units	3,800 bbls.	$3 million	Under Constr.	Summer 1952		U.O.P.	Procon
Conden	Big Spring	Crude Still	4,000 bbls.		Under Constr.	Dec., 1951			
Crown Central Petroleum	Houston, Texas	Crude Topping	2,350 bbl.	$365,000	Design				
Crown Central	Houston	Cat. Cracker	2,400 bbl.						
*Davison Chemical	Lake Charles, La.	Catalyst Plt.		$7 million	Design	Early 1953		D & Z	Consol. Eng.
Del Rey Petroleum Co.	Chesterville, Texas	Pressure Absorption Plt.	25,000 mcf		Under Constr.			O. L. Olsen	O. L. Olsen
Dodds Refining Co.	Jacksonville, Texas	Refinery Repairs							
Dow Chemical Co	Freeport, Texas	Chemicals, Expansion		$30 million	Engineering	End 1951		Staff	Tellepsen, Pritchard, Austin, Stone & Webster
Dow Chemical	Freeport, Texas	Styrene Plastics		$1.6 million	Under Constr.			Braun	Braun
Dow Chemical	Freeport	Ethylene-Dibromide Unit		$6 million	Under Constr.			Braun	Braun
Dow Chemical	Freeport	Perchlorathylene Chloride		$3 million	Under Constr.			Braun	Braun
*Eastern States Petroleum	Houston, Texas	Cat. Reformer	4,200 bbls.	$1.5 million	Under Constr.	Dec., 1951	U.O.P.	U.O.P.	Staff
*Eastern States Petroleum	Houston, Texas	Alkylation Unit	2,400 bbls.	$1 million	Under Constr.	Dec., 1951	U.O.P.	U.O.P.	Staff
E. I. Du Pont de Nemours & Co., Inc	Orange, Texas	Expand Polythene Manuf. Facilities	60 Mmcf.		Under Constr.	Late 1952			
Eddy Refining	Houston, Texas	Topping Unit	1,200 bbl.		Completed	Oct., 1951		Grebe & Doremus	Grebe & Doremus
*Esso Standard	Baton Rouge, La.	Aromatics Fac.		$3 million	Under Constr.				
*Esso Standard	Baton Rouge, La.	Crude Distills.	11,000 bbls.		Engineering				
*Esso Standard	Baton Rouge, La.	Cat Cracker	21,000 bbls.		Engineering				
Esso Standard	Baton Rouge, La.	Desalting Unit	55,000 bbls.		Under Constr.	Nov., 1951	Howe-Baker	Staff	Pioneer
Ethyl Corp.	Houston, Texas	Chemicals Mfg. Plt.	100 mln. lbs./yr.		Under Constr.	End 1951		Braun, Badger	Braun-Badger
Ethyl-Dow	Freeport, Texas	Ethylene Dibromide	60,000 lbs.	$3.2 million					
*Freeport Sulphur	Garden Is. Bay, La.	Sulfur Recovery Plt.	500,000 tons/yr.	$10-15 million	Engineering	1953			
Fullerton Oil Co.	Snyder, Texas	Refrig. Nat. Gaso. Plt.	40,000 mcf		Completed	1951			Hudson
Gilmore Refineries	Odessa, Texas	New Refinery	50,000 bbls.	$40,000 million	Design				Ford-Bacon-Davis
Gulf Oil	Pt. Arthur, Tex.	Ethylene Plt.	45,000 lbs.	$15.4 million	Under Constr.	Spring, 1953			
Gulf Oil	Pt. Arthur	Fluid Cat Crk.	60,000 bbl.	$18.4 million	Completed	Sept., 1951		Kellogg	Kellogg
Gulf Oil Corp.	Pt. Arthur, Tex.	Iso-Octyl Alcohol Fac.	24,657 lbs.		Planning	End, 1953			
Gulf Oil	Waddell, Texas	Gas Plt. Add.			Plan				
J. M. Huber Corp.	Baytown, Texas	Car. Blk. Plt.	197,000 lbs.	$1.5 million	Under Constr.	Nov., 1951		Huber	Stearns-Rogers
Humble Oil	Baytown, Texas	Refrig. for Alky Unit	Summer †900 bbls.	$177,945	Completed	Fall, 1951		Staff	Staff
*Humble Oil	Baytown, Texas	Turbo Fuel Fac.	†4,400 bbls.	$70,400	Under Constr.	Winter Qtr.			
*Humble Oil	Baytown, Texas	Pipe Still No. 5	†15,000 bbls.	$5 million	Under Constr.	Winter Qtr.		Foster Wheeler	Foster Wheeler

REFINERY AND OTHER PLANT CONSTRUCTION—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
Inland Refining	Palestine, Tex.	Cat. Poly	100 bbl.		Completed	1951	Cal Research	Grebe and Doremus	Grebe and Doremus
Inland	Palestine, Tex.	Cyclo. Unit	400 bbls.		Completed	1951	Cal Research	Grebe and Doremus	Grebe and Doremus
Inland	Palestine, Tex.	Perco Cat.	700 bbls.		Completed	1951	Phillips	Grebe and Doremus	Grebe and Doremus
Jefferson Chemical Co.	Port Neches, Texas	Ethanolamine Plt.			Under Constr.	4th Qtr., 1951		Braun	
Koppers Co., Inc.	Ft. Arthur, Tex.	Chem. Plt.			Const. June			Koppers	Koppers
Levelland Refining	Amarillo, Texas	Cat. Crk; Poly.	3000/150 bbls.	$2.4 million	Design				
Lion Oil Co.	Diamond M & Sharon Ridge Fields, Texas	Casinghead and LPG Plt.	50,000 Mcf.	$6,500,000	Completed	Aug. 1, 1951		Hudson Eng.	Hudson and Others
Magnolia	Hurricane Creek Field, Beauregard Parish, La.	Casinghead Gasoline Plt.			Designed				
McMurrey	Tyler, Texas	Vac.-Flasher	4,000 bbls.		Completed	1951		U.O.P. and Ref. Eng.	Ref. Eng.
Monarch Refining	San Antonio, Texas	Fluid Cat. Crk.	4,000 bbl.						
Monarch	San Antonio	Poly. Unit	2,500 bbl.	$12.5 million	Design	Mid 1953		U.O.P.	Koch
Monarch	San Antonio	Alky. Unit	2,500 bbl.						
Monsanto	Texas City	Styrene Plastics		$8.6 million	Under Constr.	April, 1952			
Monsanto Chemical Co.	Texas City, Tex.	Acrylonitrile Mfg. Facil.; Plt. Expansion		$30 million	Engineering	1952		Braun	
North American Oil Consolidated & Ungren & Frazier	Bartlett Field, Jones County, Texas	Gasco. Plt., Gas Injection Facilities			Planning				
Northern Natural Gas	Skellytown, Tex.	Gas Dehyd. Plt.	180,000 Mcfd		Under Constr.	Oct., 1951		Dresser	Dresser
*Ohio Oil	Matagorda, Tex.	Gas Processing	91 million cu. ft.	$4.1 million	Under Constr.	Early 1952		Hudson Eng.	Hudson Eng.
Onyx Refining Co.	Abilene, Texas	Platforming Unit, Thermal Crk. Still	580 bbls.	$650,000	Completed	1951	U.O.P.		Staff
Pan Am Petroleum & Trans.	Texas City, Tex.	Av-Gas Expan.	11,180 bbls.		Plan	End 1952			
Pan American Refining	Texas City, Tex.	Aromatics-Toluene	600 bbl.	$1.1 million	Announced				
Pan American Refining	Texas City, Tex	Alky. Expan.	120,500 bbl.		Plan	End 1952			
Pan Am Southern Corp.	Destrehan, La.	Cat. Crk. Unit Gas Plt., Alkylation	30,000 bbls.	$6.5 million	Planning	May, 1953		Lummus	Lummus
Pan-Am Southern	New Orleans, La.	Refinery Expan.		$5.5 million	Under Constr.				
Pan-Am Southern	Destrehan, La.	Fluid Hydroformer	2,000 bbl.		Under Constr.	May, 1952	S.O.D.	S.O.D.	Kellogg
*Pan-Am Southern	Destrehan, La.	Coker	9,000 bbls.		Under Constr.			Lummus	Lummus
Panhandle Prod. & Ref.	Wichita Falls, Texas	Topping Unit	6,000 bbl.		Design			Ref. Eng.	
*Pecos Petroleum	Pecos, Texas	Aromatics Expansion	240/280 bbls.		Planned				
*Phillips Chemical	Houston, Texas	Chem. Plt.		$2.5 million	Under Constr.	June, 1952			
Phillips Chemical Co.	Borger, Texas	Carbon Black Plt.	80,000 tons/yr.		Planning	4th Qtr., 1951			
Phillips Oil	Borger, Texas	Alky. Expan.		$15.5 million	Announced				
Phillips Pet.	Chocolate Bayou, Texas	Nat. Gas Plt.	3,570 bbl.		Announced				
Phillips Pet.	Dumas, Texas	Comp. Stat. Add.	250,000 Mcfd		Under Constr.	1951		Phillips	Phillips
Phillips Pet.	Goldsmith, Tex.	Sulfur Plt.	120 tons		Under Constr.	Early 1952		Parsons	Parsons
Phillips Pet.	Midland, Texas	Nat. Gas Plt.			Under Constr.				
Phillips Pet.	Phillips, Texas	Isobutane Separation	20,000 bbl.	$4 million	Under Constr.	Nov., 1951		Badger	Badger
*Phillips Petroleum	Sherman County, Texas	Natural Gas Plt.		$212,000	Under Constr.				
Phillips Pet.	Sweeney, Texas	Crude Unit	30,000 bbl.	$4.8 million	Completed	1951		Braun	Braun
Phillips Pet.	Sweeney, Texas	Alkylate Unit	1,800 bbl.	$3.6 million	Under Constr.	Oct., 1951		Braun	Braun
Phillips Petroleum	Alvin, Texas	Cycling Plt.	175,000 Mcfd	$5 million	Under Constr.	1951		Brown & Root	Brown & Root
Pontiac Refining Co. & Chicago Corp.	Corpus Christi, Texas	Ref. Petro-chem. Plt.	5,000 bbls. gaso., 170,000 bbls. ethylene glycol, 3,000 lbs. ethylene	$15 million	Design, Planning	1951			
Premier Petroleum	Ft. Worth, Tex.	Cat. Reformer	1,500 bbl.	$650,000					
Premier Pet.	Ft. Worth	Jet Fuel Butane, etc.		$3.6 million	Design				
*Premier Petroleum	Ft. Worth, Tex.	Refinery Expan.	6,000 bbls.		Planned				
Pure Oil Co.	Dollarhide, Andrews Co., Tex.	Nat. Gaso. Plt.		$6 million	Under Constr.	1951			Hudson
Pure Oil Co.	Nederland, Tex.	API Oil Sep.			Completed				Trotti and Thompson
Pure Oil	Smith's Bluff, Texas	Basic Refining		$10.8 million					
Pure Oil	Smith's Bluff	Alkylate Unit	1,901 bbl.	$390,000					
Shamrock Oil & Gas Corp.	McKee, Texas	Reconstruct Gaso. Ref. Treater		$80,000	Planning				
Shell Chemical Co.	Houston, Texas	Expand Ethylene & Ethyl Chloride Prod.; Glycerine Plt. Extension			Under Constr.	4th Qtr. 1951		Fluor	Fluor
Shell Oil	Houston, Texas	Benzene-Toluene	1,250/2,500 bbl.	$4.6 million	Under Constr.			Foster Wheeler	Foster Wheeler
Shell Oil	La Porte, Texas	High Octane Expan.			Announced			U.O.P.	Procon
Shell Oil Co.	Houston, Texas	Platforming Unit	15,000 bbl.	$12 million	Under Constr.	Oct., 1951	U.O.P	U.O.P.	Procon
Sid N. Richardson	Odessa, Texas	Sulfur Recovery	20 tons		Engineering	End 1951*		Graff	Graff
Sid Richardson Refining Co.	Texas City, Tex.	Refinery Alterations	30,000 bbls.		Under Constr.	1951		Staff	Staff
Sinclair Refining	Houston, Texas	Crude Topping	25,000 bbl.	$27 million	Announced				
Sinclair	Houston	Cat. Cracker	40,000 bbl.						
Sinclair	Houston	Desalting Unit	37,000 bbl.		Under Constr.	End, 1951	Howe-Baker	Staff	Staff
Southwestern Oil & Refining	Corpus Christi, Texas	Crude Topping	15,300 bbl.	$5.5 million	Design				
Southwestern	Corpus Christi	Cat. Crk.-Poly.	5,000/300 bbl.						
Standard (Texas)	El Paso, Texas	Alkylation Unit	1,600 bbl.	$2.7 million	Start Fall, 1951			Kellogg	Cat. Constr.
Standard (Texas)	El Paso	Expansion & Modern Crk.	11,000 bbl.	$10.2 million	Under Constr.	July, 1952	Houdry	Cat. Constr.	Cat. Constr.
Standard (Texas)	Houston, Texas	Natural Gasol		$1.2 million	Announced				

REFINERY AND OTHER PLANT CONSTRUCTION—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
*Stanolind Oil	Shreveport, La.	Gas Stripping	1.5 million cu. ft.		Under Constr.			Blaw-Knox	Blaw-Knox
Sun Oil	Delhi, La.	Topping-Benzene	120/197 bbl.	$238,497	Announced				
*Sunray	Corpus Christi, Texas	Cat Cracking Refinery	25,000 bbls.	10 million	Constr. this Qtr.		U.O.P.-Petreco		
Superior Oil Co.	Ramsey Field, Colo. Co., Tex.	Nat. Gaso. Plt.	80,000-70,000 mcf. gas	$1.5 million	Under Constr.	1951		Brown & Root	Brown & Root
Taylor Refining Co	Corpus Christi, Texas	TCC Unit	18,000 bbls.		Under Constr.	1951	Socony-Vacuum	Lummus	Lummus
Taylor Refining	Corpus Christi	Crude Unit	21,000 bbl.		Under Constr.			Lummus	Staff
Taylor Refining Co. and Mayfair Minerals, Inc.	Port Isabel, Tex.	Platforming Unit	14,000 bbls.		Under Constr.	Sept., 1951	U.O.P.	U.O.P.	Staff
Tennessee Eastman	Longview, Tex.	Ethyl Alcohol		$5.7 million	Announced				
*The Texas Co	Pt. Arthur, Tex.	Expansion	20,000 bbls.		Under Constr.				
Tex.-Harvey Gas	Midland, Texas	Gas Plt.; Refrig.	35 Mcf wet	$5.5 million	Under Constr.	July, 1952			
United Carbon Co.	Shamrock, Texas	Carbon Black Plt.	66,800 lbs.	1.5 million	Under Constr.	1951			
United Gas Pipe Line	Sterlington, La.	Dehydration	125,000 mcf		Under Constr.				Staff
United States Rubber Co.	Baton Rouge, La.	Buna W Rubber Plt. Expan.	62,200 lbs.		Under Constr.	Early, 1952			
*Wickett Refining	Wickett, Texas	Thermal Crker	2,000 bbls.		Under Constr.				
ROCKY MOUNTAIN									
Bureau of Mines	Rifle, Colo.	Demonst. Retort.	150-400 ton	$333,870	Engineering	June, 1952		Blaw-Knox	Staff
Continental Sulphur & Phosphate Corp.	Cody, Wyo.	Sulfur Extraction			Contracted				Chem. Const.
*Famarin Oil	Monument,	Expansion	1,200 bbls.	$80,000	Completed			Ref. Eng.	Staff
*Farmers Union Central Exc.	Laurel, Mont.	Fluid Cat Crker	5,000 bbls.		Under Constr.			Ref. Eng.	Ref. Eng.
Filtrol Corp.	Salt Lake City, Utah	60 ton Cat. Crk.	447 bbls.	$725,400	Considering				
Filtrol	Salt Lake City	100 ton Cat. Crk.	745 bbls.	$1.9 million	Considering				
Frontier	Loco Hills, N. M.	Natural Gasoline	10,000 Mcfd						
Garfield Chemical & Mfg. Corp.	Salt Lake City	Sulfuric Acid		$2.5 million	Plan				
New Mexico Asphalt and Refining Co.	Artesia, N.M.	Ptg. TCC Unit, Cat. Poly Unit	6,000 bbls. 300 bbls.	$2.5 million	Under Constr.	Aug., 1951	Socony-Vacuum Hydro Res.		Sweco Sweco
Oriental Refining Co.	Denver, Colo.	Ferro Cyclovrersion Unit	1,500 bbls.		Under Constr.				
Phillips Petroleum Co.	Woods Cross near Salt Lake City, Utah	Vac. Plt., Gas Plt.; Storage, Cat. Crk.	8,000 bbls.	$10 million	Constr. Aug. 1951	July, 1953		Fluor	Fluor
*Pure Oil	Worland, Wyo.	Sulfur Recovery Plt., etc.	30 million cu. ft. gas		Engineering			Foster Wheeler	Tex. Gulf Sulphur
Southern Union Gas	Farmington, N. M.	H2S Extension			Under Constr.	End, 1951		Graff	Staff
Western States Refg.	Salt Lake City, Utah	Topping; Crker.	2,000/2,300 bbls.	$1.1 million					
WEST COAST									
American Smelting & Refining	Tacoma, Wash.	Sulfuric acid		$891,730	Announced				
*Caminol	Hanford, Calif.	Crude Expan.	5,000 bbls.	$45,000	Completed			Staff	Staff
Dow Chemical	Pittsburgh, Cal.	Methylene Chloride		$670,000	Under Constr.	June, 1952			
Eureka Refining	Long Beach, Cal.	Cat. Crker	6,000 bbls.	$2.2 million					
Fletcher Oil	Rancho San Petro, Cal.	Thermal Crker Addition	700 bbls.	$176,250					
Hancock Oil Co.	Long Beach, Cal	Ethylene Glycol	20,000 bbls.		Under Constr.			Badger	Badger
*Richfield Oil	Watson, Calif.	Cat Cracker	6,000 bbls.		Under Constr.			Braun	Braun
Rothschild Oil	Santa Fe Springs, Cal.	Cat. Crker.	6,000 bbls.	$2 million					
Shell Chemical	Shell Point, Calif.	Synthetic Ammonia Plt.			Planning				
Shell Chemical	Shell Point	Refinery	25,000-30,000 bbls.	$35 million	Planning				
*Shell Chemical	Dominguez, Calif.	Synthetic Ammonia Plt.			Under Constr.	Late 1953			
Shell Chemical	Dominguez, Calif.	Added M1BK Prod. Capacity			Under Constr.	3rd Qtr., 1951		Braun	Braun
Shell Chemical	Martinez, Calif.	Octyl, Formal Plt. Expansion			Under Constr.	1951		Bechtel	Bechtel
Signal Oil & Gas	Los Angeles, Cal	Butanes-Isobutane		$500,000					
Standard (Cal.)	El Segundo	Feed Preparation			Under Constr.	June, 1953		Fluor	Fluor
Standard (Cal.)	El Segundo	Platformer	10,000 bbls.	$7.4 million		June, 1953	U.O.P.	U.O.P.	Procon
*Standard (Calif.)	Richmond, Calif.	Chem. Plt.		$1.5 million	Engineering				
Standard Oil of Calif.	Richmond, Calif.	TCC to Houdry	7,500 bbls.	$9 million	Under Constr.	Dec., 1951	Houdry	Houdry	Bechtel
Standard Oil of Calif.	El Segundo, Calif.	Benzene Plt.	850 bbls. Benzene, 3,200 bbls. Toluene	$10 million	Under Constr.	Mid 1952	U.O.P.	Fluor	Fluor
*Stauffer Chemical	Compton, Calif.	Sulfuric Acid Fac.		$57,070	Engineering				
Stauffer Chemical	Richmond, Cal.	Sulfuric acid		$283,500					
Sunland Refining	Bakersfield, Cal.	Thermal Crker	900 bbls.	$501, 653	Under Constr.	Nov., 1951		U.O.P.	Sunland
Sunray Oil	Santa Maria, Cal.	Reconstruction	5,000 bbls.					Process Constr.	Process Constr.
Union Oil Co. of Cal.	Brea Olinda, Cal.	Research Plt.		$5 million	Projected	1951		Austin, Field and Fry	Walker
Union Oil Co.	Los Angeles, Calif.	Fluid Cat. Crk. Unit	28,000 bbls.	$8 million	Planning	Feb., 1952	U.O.P.	McKee	McKee
Union Oil	Los Angeles, Cal.	Crude Topping	20,000 bbls.	$12 million					
Union Oil	Los Angeles	Alkylate Fac.	250 bbls.	$135,000					
Union Oil	Oleum, Cal.	Asphalt Revin.		$275,000	Under Constr.	Fall, 1951		E. & A.	E. & A.
Union Oil	Wilmington, Cal.	Cat. Cracker	25,800 bbls.	$4.5 million					
*Union Oil	Wilmington, Calif.	Acid Treater Rerun	15,000 bbls.		Under Constr.			Union-Braun	Braun
Union Oil	Wilmington	Av.-Gas		$138,000					
Union Oil Co. of Calif.	Edmonds, Wash.	Asphalt Refining	65,000 tons/yr.	$1 million	Completed	1951		Bechtel	Bechtel
U. S. Navy and Standard Oil of Calif.	Elk Hills, Calif.	Nat. Gas Plt.	50 Mmcf.		Planned	April, 1952			
FOREIGN									
Canada									
British-American	Moose Jaw, Sask.	Cat. Crk., Coker Thermal Crk., Cat. Poly., Utilities	10,000 bbls.	$5.5 million	Under Constr.	Dec., 1951	U.O.P. (Cat. Crk. & Cat. Poly.)	Texas Eng.	Texas Eng.

REFINERY AND OTHER PLANT CONSTRUCTION—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
British American Oil and Shawinigan Chemicals	Montreal, East	Petro Chemical Plt.	.....	.....	Planning	.....	.....	.....	.....
Godfrey L. Cabot	Sarnia, Ont.	Carbon Black Plt.	.....	$1 million	Planning	.....	.....	.....	.....
Canadian Chemical Co.	Edmonton Area, Alberta	Petro Chemica Plt.	.....	$40 million	Under Constr.	Sept., 1953	.....	Celanese-Brown Root	Brown Root
Canadian Oil Refineries	Broomfield, Ont.	Refinery	20,000 bbls.	$18 million	Under Constr.	April, 1953	.....	Can. Kellogg	Can. Kellogg, Process
Celanese Corp.	Edmonton, Alta.	Plat. Unit	3800 bbls.	.....	Under Constr.	1952	U.O.P	U.O.P.	.....
Dominion Tar & Chemical Co., Ltd.	Montreal East	Chemical Plt.	.....	$40 million	Announced	.....	.....	.....	.....
Excelsior Refs., Ltd.	Lloydminster, Alberta	Petro Chemical Plt.	.....	$6 million	Design	End 1953	.....	Badger	Badger
Excelsior Refs., Ltd.	Lloydminster	Inc. Capacity	3,000 bbls.	.....	Under Constr.	1951	.....	.....	.....
Imperial Oil, Ltd	Regina, Saskatchewan	Inc. Capacity	1,500 bbls.	.....	Design	1951	.....	.....	.....
Imperial Oil	Winnipeg	Desalting Unit	16,000 bbls.	.....	Completed	1951	Howe-Baker	Staff	Staff
Imperial Oil	Edmonton, Alberta	New Refinery	10,000 bbls.	$10 million	Completed	1951	.....	Canadian Kellogg	Canadian Kellogg
Imperial Oil	Sarnia	Fluid Cat. Crk., Gas Recov. Fil. Vac. Dist. Unit	20,000 bbls.	$5 million	Under Constr.	Summer 1953	.....	Standard Oil Dev. Co.	Foster Wheeler
Imperial Oil	Sarnia	Fluid Cat. Crk., Dist., Light Ends Recov.	71,000 bbls.	$14 million	Under Constr.	Summer 1953	.....	Kellogg	Can. Kellogg
Imperial Oil	Sarnia	30 Storage Tanks	2 million bbls.	.....	Under Constr.	Summer 1952	.....	Toronto Iron Works	Horton Steel
Imperial Oil	Edmonton, Alta.	Desalting Unit	22,000 bbls.	.....	Completed	1951	Petreco	Staff	Staff
McColl Frontenac Oil Co., Ltd.	Edmonton, Alta.	Crd. Processing Cat. Crk.	5,500 bbls.	$10 million	Completed	Sept., 1951	.....	Foster Wheeler	Foster Wheeler
Midland Pet. & Pacific Pet.	Stettler, Alta.	Crude Refinery	4,000 bbls.	$3 million	Under Constr.	.....	.....	Process Constr.	Process Constr.
Panther Oil and Grease Co.	Leaside, Toronto, Ontario	Grease and Compounding	.....	.....	Projected	.....	.....	.....	.....
Shell Oil	Jumping Pound, Alta.	Sulfur	33 tons	$300,000	Engineering	Early, 1952	.....	.....	.....
Shell (Canada)	Montreal, East	Petro Chem Plt.	30,000 lbs.	$3 million	Under Constr.	Late 1952	.....	.....	.....
Shell Oil	Shellburn, Ver.	Refinery Warehouse	.....	$300,000	.....	.....	.....	.....	.....
*Sun Oil	Sarnia, Ont.	Refinery	10-15,000 bbls.	$10 million	Spring, 1952	March, 1953	Houdry	Cat. Const.	Cat. Constr.
Supreme Refineries	Ogden, Alta.	Refinery	1,000 bbls.	$100,000	Under Constr.	1951	.....	Staff	Staff
Supreme Refineries	Ogden, Alta.	Asphalt Plt.	.....	.....	Planning	.....	.....	.....	.....
Latin America									
*Brazilian Investments	Niteroy, Rde J., Brazil	Refinery	20,000 bbls.	.....	Petitioned	.....	.....	.....	Kellogg
Conselho Nacional do Petroleo	Bahia, Brazil	Expansion	5,000 bbls.	.....	Under Constr.	.....	.....	Kellogg	Kellogg
Conselho Nacional do Petroleo	Cubatao, Sao Paulo, Brazil	Therm. Crk. Ref. Reforming, Vis. Breaking Cat. Poly	45,000 bbls.	.....	Under Constr	End, 1953	.....	PA Hydro Res.	PA Hydro Res.
Conselho Nacional do Petroleo	Mataripe, Bahia, Brazil	Ref. Expn Cat. Poly L.P.G., Plt.	2,500 bbls.	$3.5 million	Under Constr.	Sept., 1952	.....	Kellogg	Kellogg
Conselho Nacional	Salvador, Brazil	Combination Plt.	2,500 bbls.	.....	Completed	.....	.....	Kellogg-P.A.	Staff
Conselho Nacional	Salvador, Brazil	Cat. Poly. LPG	5,000 bbls.	.....	Under Constr.	.....	.....	Kellogg-P.A.	Staff
The Corporacion de Fomento de la Producion	Concon, Valparaiso, Chile	Refinery	14,000 bbls.	$9 million	Planning	1953	.....	.....	.....
Creole Pet. Corp.	El Roble Field, Venezuela	Repressuring	.....	.....	Planning	.....	.....	.....	.....
*Creole Petroleum	Jusepin, Venezuela	Revamp Ref.	.....	.....	Under Constr.	.....	.....	.....	Braun
Empresa Nacional del Petroleo	Cerro Manantiales, Tierra del Fuego	Crude Stabiliser, Nat. Gas., L.P. G. and Recycling	30,000 mcf gas	$2.6 million	Under Constr.	Nov., 1951	.....	Hudson Eng.	Staff under Hudson
*Empresa Nacional de Petroleo	Concon, Chile	Refinery	15,000 bbls.	$2 million	Planned	.....	.....	.....	.....
Ipiranga S.A. Cia Brasilira de Petroleos	Rio Grande, Brazil	Therm. Crk. Ref.	2,000 bbls.	.....	Authorized	1952	Foster Wheeler	.....	.....
Monsanto S.A.	Sao Paulo, Brazil	Plastics Plt.	.....	.....	Under Constr.	Late 1952	.....	.....	.....
Petroleos Mexicanos	Atscapotzalco	Desulfurization Plt.	12,000 bbls.	$995,000	Under Constr.	Nov., 1951	Perco	Phillips-McKee	McKee
Petroleos Mexicanos	Mazatlan	Refinery	15,000 bbls.	.....	Projected	.....	.....	.....	.....
Petroleos Mexicanos	Ciudad Madero, Mexico	Desulfurization Units	12,000 bbls.	$1.5 million	Under Constr.	Dec., 1951	Perco	McKee-Phillips	McKee
Petroleos Mexicanos	Tamaulipas, Ciudad Madero, Mex.	Enlarge Refinery Capacity	47,280 bbls.	.....	Planning	1951	.....	.....	.....
Petroleos Mexicanos	Tamaulipas, Arbol Grande Pet., Mex.	Enlarge Refinery	16,000 bbls.	.....	Planning	1951	.....	.....	.....
Petroleos Mexicanos	Poza Rica, Mex.	Desulfurization Units	3,000 bbls.	$400,000	Planning	1951	Perco	Phillips	Staff
Petroleos Mexicanos	Mata Redonda, Vera Cruz, Mex.	Improvements	9,000 bbls.	.....	Planning	1951	.....	.....	.....
Petroleos Mexicanos	Poza Rica, Mex.	Improvements to Skimming Plant	3,100 bbls.	.....	Planning	1951	.....	.....	.....
Petroleos Mexicanos	Reynosa, Mex.	Expansion	.....	.....	Planning	.....	.....	.....	.....
Petroleos Mexicanos	Salina Cruz, Mexico	Refinery	.....	.....	Planning	.....	.....	.....	.....
Petroleos Mexicanos	Salamanca, Mex.	Lube Oil and Paraffin Plt.	2,500 bbls.	$18 million	Under Constr.	1953	Texaco	McKee	McKee
Phillips Oil Co.	San Roque Fld., Anzoategui, Venezuela	Refinery, Wax Plt.	2 mln. lbs. wax/year	.....	Under Constr.	April, 1952	.....	Pritchard	Chicago B. & I.
Phillips	San Roque Fld., Anzoategui, Venezuela	Crude Stab. and Pressure Maint. Plt.	10,000 bbls. and 58 Mmcf	.....	Planning	.....	.....	.....	.....
Phillips	San Roque	Crude Distill.	3,000 bbls.	.....	.....	.....	.....	.....	Kellogg
Private Group	Rio de Janeiro, Brazil	Refinery	20,000 bbls.	.....	.....	.....	.....	.....	.....
Puerto Rican Oil Refining Co.	Near Ponce, Puerto Rico	Refinery	25,000 bbls.	$20 million	Projected	1951	Undetermined	Parsons, Brinckerhoff, Hall and Macdonald	.....

■ Table continued on page 97

SERVICE LEDGER
1901–1951

ANGLO-IRANIAN OIL CO. LTD.
ARGENTINE GOVERNMENT OIL FIELDS
ARGENTINE MINISTRY OF WAR
ATLANTIC REFINING CO.
ATOMIC ENERGY COMMISSION
BRITISH AMERICAN OIL CO. LTD.
CANADIAN OIL REFINERIES, LTD
CALIFORNIA REFINING CO.
CHAMPLIN REFINING CO.
CIE. DE RAFFINAGE SHELL-BERRE
CIE. FRANCAISE DE RAFFINAGE
CIE. INDUSTRIELLE DES PETROLES
CITIES SERVICE OIL CO.
CITIES SERVICE REFINING CORP.
COLGATE-PALMOLIVE-PEET
CONSOLIDATED REFINERIES, LTD.
CONTINENTAL OIL CO.
CORY BROTHERS & CO., LTD.
CREOLE PETROLEUM CORP.
DIAKEL CORPORATION
EL DORADO REFINING CO.
ESSO STANDARD OIL CO.
GENERAL PETROLEUM CORP. OF CALIFORNIA
GLOBE OIL & REFINING CO.
GULF OIL CORP.
HUMBLE OIL & REFINING CO.
IMPERIAL CHEMICAL INDUSTRIES
IMPERIAL OIL LTD.
KANOTEX REFINING CO.
KENDALL REFINING CO.
LEVER BROS.
LION OIL CO.
MAGNOLIA PETROLEUM CO.
MARINE OIL REFINERS OF AFRICA, LTD.
MATHIESON CHEMICAL CORP.
McCOLL-FRONTENAC OIL CO., LTD.
MID-CONTINENT PETROLEUM CORP.
MITSUBISHI OIL CO., LTD.
NATIONAL PETROLEUM COUNCIL OF BRAZIL
PAN AMERICAN REFINING CORP.
PENNZOIL CO.
PHILLIPS PETROLEUM CO.
POLYMER CORP., LTD.
PURE OIL CO.
SHELL CHEMICAL CORP.
SHELL OIL CO.
SHERWIN-WILLIAMS CO.
SINCLAIR REFINING CO.
SKELLY OIL CO.
SOCIETE DES RAFFINERIES DE PETROLE DE LA GIRONDE
SOCIETE GENERALE DES HUILES DE PETROLE
SOCIETE INDUSTRIELLE BELGE DES PETROLES
SOCONY-VACUUM FRANCAISE
SOCONY-VACUUM OIL CO.
E. R. SQUIBB & SONS
STANDARD OIL CO. (INDIANA)
STANDARD OIL CO. (OHIO)
STANDARD OIL CO. OF CALIFORNIA
SWIFT AND CO.
TEXAS CO.
UNION OIL CO. OF CALIFORNIA
UTAH OIL REFINING CO.
WASATCH OIL CO.
WOOD RIVER OIL & REFINING CO.

D-X

Building for product improvement ...with Mid-Continent!

First order from the Mid-Continent Petroleum Corporation, in 1939, was for lube improvement units... deasphalting and acid treating. The following year we were busy again, this time in the gasoline end of the operation, engineering and constructing Mid-Continent's first catalytic polymerization unit.

As part of its immediate post-war operations, Mid-Continent ordered a Kellogg Fluid catalytic cracker to lift the overall refinery octane level... and this unit went on stream in 1949. Then just last year Kellogg engineered an alkylation unit for this refiner... a unique one inasmuch as it was designed to run in process series with Mid-Continent's modernized cat-poly unit. This operating technique squeezes the maximum volume of high octane fuels from the gaseous by-products of other refinery processes.

THE M. W. KELLOGG COMPANY

A SUBSIDIARY OF PULLMAN INCORPORATED

for fifty years an integral part of processing history

NEW YORK JERSEY CITY LOS ANGELES TULSA HOUSTON TORONTO LONDON PARIS

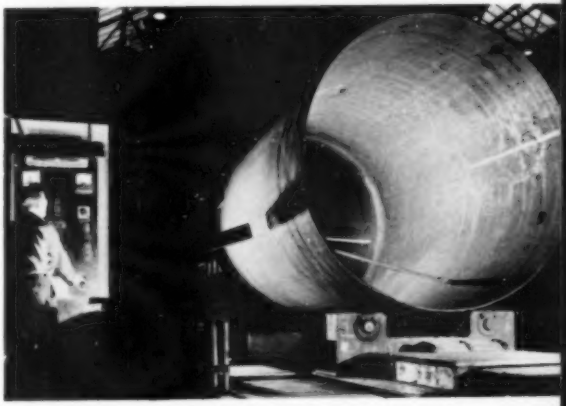
Portrait at

This year is Kellogg's fiftieth of service to industry. At this time naturally, as a group of men—known collectively to the modern business world as The M. W. Kellogg Company—we can think back nostalgically. We can remember the chimney stacks

"Unusual Techniques Set High Quality Level..."

In previous issues of this magazine, "camera portraits" of M. W. Kellogg today have highlighted major aspects of Kellogg's broad research, development, engineering and procurement activities . . . and introduced readers to the company's fabrication facilities.

This month, the camera continues its tour of Kellogg's Jersey City Shops, focusing particularly on some unusual techniques employed by Kellogg to maintain the highest quality in fabricated process piping and equipment.



1. *OUR COMPANY WAS ONE OF THE FIRST* fabricators to adopt radiography in its Shops as a quality check—and early developed one of the most extensive radiographic operations in the industry. Beyond utilizing this method as a positive check on specific jobs, Kellogg employs it to evaluate new welders and also to maintain daily welding operations at a high quality level.

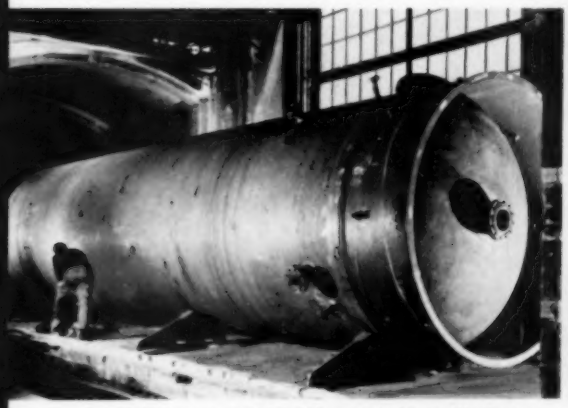
4. *A RECENT INNOVATION* in shop procedure for the fabrication of critical power station piping is the ultra-sonic testing of "raw" pipe. Developed in conjunction with a leading turbine manufacturer, this application of a modern testing technique should prevent the costly failures that have occasionally occurred because of internal flaws that cannot be discovered by any other practical method.

5. *AS FAR AS SIZE IS CONCERNED,* the Shop's facilities for making process piping are virtually unlimited. Pictured is one of industry's first machines for continuous longitudinal welding of the interior of pipe. The use of advanced equipment is typical of Kellogg shops . . . in fact, almost every step in fabrication is accompanied by either exclusive techniques or exclusive equipment.

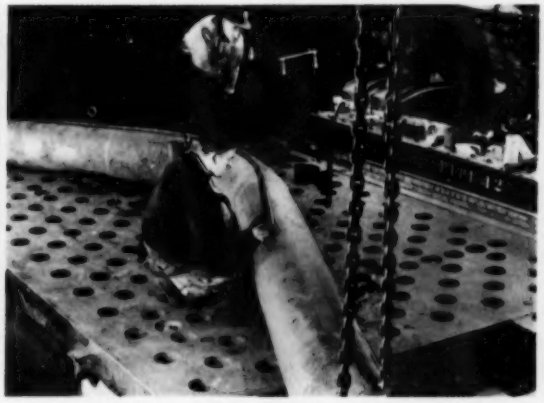
Fifty... no 9

KELLOGG 1901-1951 50th Anniversary

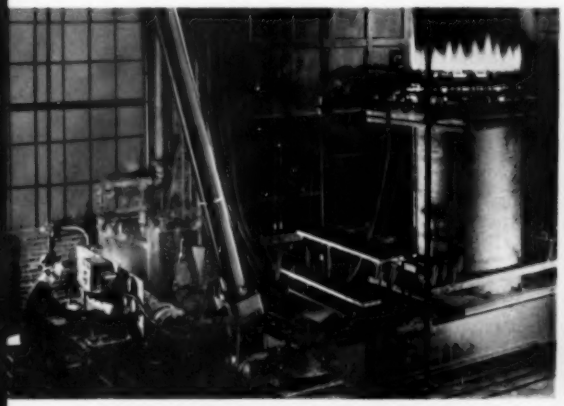
we built in 1901 . . . the first crude vessels for oil refiners in the 'teens . . . our first combination unit . . . the forty-odd Fluid cat crackers built in these years. But, after all, The M. W. Kellogg Company is only a factor as it is able to serve industry today. For that reason, we are presenting this series of monthly camera studies which document our belief that a truly integrated organization can better serve industry to achieve greater earning power. This is No. 9 in the series.



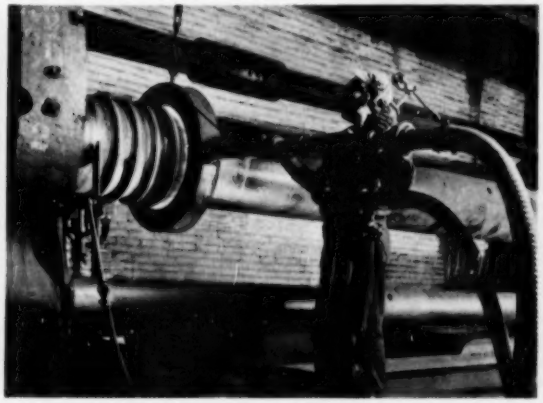
2. *STRESS RELIEVING FURNACES* are a basic element of the Shops' facilities. However, from this more-or-less routine shop operation, Kellogg metallurgical groups have evolved special stress relieving "specs" and techniques that have proved invaluable in the field—both in fabrication of vessels and in the installation of piping systems for power and process applications.



3. *PROCESS PIPING OF ALL TYPES* represents a major part of the Shops' volume—with high-temperature, high-pressure piping systems for utility power stations also being an important phase of Contract-Engineering volume. Some recent Kellogg firsts in this latter highly specialized field are the first installation to operate at 1050°F and 1730 p.s.i.g. and the first stainless steel alloy installation.



6. *THIS KELLOGG INVENTION* can bend process pipe up to 96 inches in diameter . . . with continuous, even contour. Operated through electrical controls, the machine produces giant pipe bends that have promoted processing efficiency by minimizing erosion and stress corrosion and markedly reducing turbulence.



7. *ON THIS MACHINE, KELLOGG* fabricated the first 30 inch O.D. diameter alloy corrugated piping through use of much the same technique as employed on the Giant Bender: controlled incremental heating and subsequent controlled application of pressure.

NEXT MONTH

. . . in the tenth of this series of camera studies of M. W. Kellogg today . . . the camera completes the Shop story and moves out on the construction lot to review some of the methods Kellogg employs to win "construction's battle with time."

Low maintenance...welded in!

M. W. KELLOGG

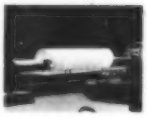
Such details as the positioning of this simple weld on an exchanger baffle plate can radically vary maintenance costs of an operating exchanger. Low maintenance costs have been a design fetish of Kellogg engineers for many years. They design with low maintenance as a principal "spec"... then see that the "spec" is reproduced in every piece of Kellogg-fabricated equipment.

Pressure Vessels
Vacuum Vessels
Fractionating Columns
Drums and Shells
Heat Exchangers
Process Piping
Hi-pressure—Hi-temp Power Piping
Bends and Headers
Giant One-Piece Bends
Forged and Welded Fittings
Radial Brick Chimneys

Continuing Basic Study of heat exchange by Kellogg development groups over 20 years has produced unduplicated design data.

Shop Layout Craftsmen have had experience on all types of heat exchangers, from marine condensers to jet engine combustion-chambers.

Rigid Quality Control is maintained by inspectors reporting directly to *Shop Management* rather than to *Production* executives.



Extensive Shop Facilities, from plate forming to stud threading, permit *complete* fabrication of any type heat exchanger.

Special Shop Techniques—the component parts of each exchanger are fabricated as a production unit, building in the advantages of "tailor-made" fit.

NEWS FOR OPERATORS IN WESTERN CANADA!

The Canadian Kellogg Company Ltd. has established complete shop facilities for the fabrication of all types of piping at **EDMONTON**, Alberta. Inquire directly or through any Kellogg or Canadian Kellogg office.

The M. W. Kellogg Company *(A Subsidiary of Pullman Incorporated)* **New York, Jersey City, Los Angeles, Tulsa, Houston, Toronto, London, Paris**

REFINERY AND OTHER PLANT CONSTRUCTION—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
Refinaria de Petroleo do Districto Federal S.A.	Manguinhos, Brazil	Refinery	10,000 bbls.	$10 million	Contracted	Aug., 1952	.....	.....	.....
Refinaria de Petroleos do Distrito Federal S.A.	Rio de Janeiro, D. F. Brazil	Therm. Crk.	10,000 bbls.	.....	Authorized	.....	.....	Foster Wheeler	Foster Wheeler
Refinaria e Exploracao de Petroleo Unico S.A.	Capuava, Sao Paulo, Brazil	Therm. Crk. Ref.	20,000 bbls.	.....	Authorized	.....	.....	P.A. Hydro. Res.	P. A. Hydro. Res.
Richmond Exploration Co.	Bajo Grande, Venezuela	New Refinery	35,000 bbls.	.....	Referred	.....	.....	.....	.....
Shell Co. of Venezuela	Cardon, Ven.	Comprehensive Refg.	28,000 bbls.	.....	Under Constr	Early 1953	.....	.....	.....
Trinidad Leaseholds, Ltd.	Trinidad	Refinery addition	.....	$300,000	Designing	.....	.....	H.W.P.	H.W.P.
Yacimientos Petroliferos Fiscales	Buenos Aires, Argentina	New Refinery	28,000 bbls.	$54 million	Design	1951	.....	Kellogg	Kellogg
YPF	La Plata, Argentina	Crude Topping, Gaso Treating	50,000 bbls.	$2.8 million	Under Constr.	1951	.....	Houdry Procom Cat. Constr.	Cat. Constr.
YPF Boliviano	Sucre, Bolivia	Additional Unit	3,000 bbls.	.....	Under Constr	1951	.....	.....	Foster Wheeler
Europe and Africa									
Esso Petroleum	Fawley, Eng.	Refinery	110,000 bbls.	$150 million	Completed		.....	Foster Wheeler	Foster Wheeler
Esso Petroleum	Fawley, Eng.	Poly Unit	.....	.....	Completed	.....	.....	.....	.....
Esso Petroleum	Fawley, Eng.	SO_2 Extraction	13,000 bbls.	.....	Completed	.....	.....	Badger	Badger
Esso Petroleum	Fawley, Eng.	Fluid Cat. Crk.	1 million gals.	.....	Completed	Aug., 1951	.....	Esso Eng.	Foster Wheeler
Anglo Iranian	Kent, England	Expansion	80,000 bbls.	.....	Under Constr.	1952	.....	.....	.....
Anglo-Iranian Oil	Isle of Grain, Eng.	New Refinery	40,000 bbls.	.....	Under Constr.	End, 1952	.....	Badger, Lummus, Kellogg	Badger, Lummus, Kellogg
Anglo-Transvaal Consolidated Investment Co.	Vall River, Union of South Africa	Synthetic Gasoline and Diesel Oil Plt.	.....	$50-60 million	Contracted	.....	.....	Hydro. Res.	.....
Aquila, S.A.	Trieste, Italy	Prop. Deasph., Furf. Sol. Ref. MEK Dewax. Contact Filtr. Dist. & Blending Plt.	100 tons 95 UI Lubes & Bright Stocks 8 tons all Paraffin Waxes	$7.9 million	Under Constr.	1951	Juik, Texaco	Badger	Badger
Aquila, S.A.	Trieste, Italy	Lube Oil Ref.	900 bbls.	$7.9 million	Under Constr.	Fall, 1951	Juik, Texaco	Badger	Badger
Azienda Generale Italiana Petroli	Cortemaggiore Field, Italy	Gasoline Extraction Plt.	105 Mmcf	$2.5 million	Under Constr.	End 1951	.....	J. F. Pritchard & Co.	North American Pet. Gas Corp.
Batnafsche Pet. Mij.	Pernis, Holland	Expansion	73,500 bbls.	.....	Completed	2nd Half, 1951	.....	.....	.....
Benzene & Pet. Co. of Hamburg	Hamburg-Finken, Werder, Germany	Expansion	660,000 bbls.	.....	Announced	.....	.....	.....	.....
William Briggs & Sons, Ltd.	Camperdown, Scotland	Crude Dist. Fac.	1,000 bbls.	.....	Under Constr.	Early 1952	.....	.....	.....
California-Texas Oil Co.	Pernis, Netherlands	Expanding Refinery	25,000 bbls.	.....	Under Constr.	Early 1952	.....	Various Local	Various Local
Cie de Raffinage Shell-Berre	Berre, France	Expansion	65,000 bbls.	$31.6 million	Under Constr.	Early, 1953	.....	.....	.....
Shell-Berre	Petit Couronne	Teepol Plt.	25,000 tons/yr.	.....	Under Constr.	1951	.....	.....	.....
Shell-Berre	Petit Couronne, France	Lube Unit	.....	.....	Planned	.....	.....	.....	.....
Cie Francaise de Raffinage	La Mede, France	Cat. Crk., Gas Recov. System	11,500 bbls.	$10 million	Authorized	1953	.....	.....	.....
Cie Francaise de Raffinage	Gonfreville, France	Gas Recov. System							
Cie. Francaise de Raffinage	Gonfreville, France	Therm. Reform., Prop. Deasp., Furf. Trtng.	4,750 bbls.	$11 million	Under Constr.	1952	Texaco & Juik	Kellogg	Local
Cie. Francaise de Raffinage	Gonfreville, France	Lube Unit	2,500 bbls.	.....	Completed	1951	Texaco	Kellogg-Lummus	.....
Cia Espanola de Petroleos, S.A.	Sta. Cruz de Tenerife, Canary Islands	Propane-Butane Fractionating	304 bbls.	$100,000	Completed	1951	.....	U.O.P.	U.O.P.
C.E.P.S.A.	Santa Cruz de Tenerife	Reforming Unit	6,000 bbls.	$1 million	Planned	.....	U.O.P.	U.O.P.	Foster Wheeler
C.E.P.S.A.	Canary Islands	Propane-Dena.	700 bbls.	$300,000	Completed	1951	SOD.	Foster Wheeler	Foster Wheeler
C.E.P.S.A.	Santa Cruz de Tenerife (Canary Islands)	Percolation Unit	400 bbls.	.....	Completed	1951	.....	.....	.....
Condor, S.P.A. Per l'Industriale Pet. Chemica	Rho, Italy	New Refinery	27,000 bbls.	.....	Under Constr.	1952	.....	Badger	Badger
		Cat. Cracker	†15,000 bbls.	.....	Under Constr.	1952	.....	Badger	Badger
Condor	Rho, Italy	Atm. Dist. Plt.	30,000 bbls.	.....	Under Constr.	1952	.....	Badger	Badger
Condor	Rho, Italy	Feed Prep., TCC Unit	15,000 bbls. 10,000 bbls	.....	Under Constr. Under Constr.	1951 1951	..... Soc. Vac.	Badger Badger	Badger Badger
Condor	Rho, Italy	Recov. Purification Plt., Adm. Bldg., Pwr. House	.....	.....	Under Constr.	1952	.....	Badger	Badger
Danish Government	Denmark	Refinery	21,000 bbls.	.....	Planned	.....	.....	.....	.....
Deutsche-Amerikanische Petro-Gesellschaft (Esso)	Hamburg-Harburg, Germany	Cracking Plt.	9,643 bbls.	.....	.....	4th Qtr., 1953	.....	.....	.....
Deutsche Erdoel, A. G.	Heide, Germany	Cracking Fac.	†2,800 bbls. Gas †1,250 bbls. Diese	.....	.....	Dec., 1951	.....	.....	.....
Deutsche Vacuum Oel A.G.	Hamburg, Germany	Cracking Unit	8,000 bbls.	.....	Under Constr.	Sept., 1952	.....	Socony-Vac.	Hutte
Egyptian Government	Cairo, Egypt	Crude Plt.	.....	.....	.....	.....	.....	Lummus	Lummus
Egyptain Government	Suez, Egypt	Inc. Refn. Cap.	26,000 bbls.	$2,500,000	Planning	.....	.....	.....	Lummus
*Empresa Nacional	Puertollano, Spain	Shale Oil Ref.	3,000 bbls.	.....	Under Constr.	1952	.....	.....	.....
Esso Standard Refg.	Antwerp, Belg.	New Refinery Incl. Crker.	25,000 bbls.	.....	Authorized	July, 1953	.....	Standard Oil Dev. Co.	.....
Gewerkschaft Erdoel-Raffinerie Emsland	Near Lingen, Germany	Refinery	11,535 bbls.	$8,670,000	Under Constr.	4th Qtr., 1952	Houdry	Lummus	Lummus
		Houdry Cat.	7,000 bbls.						
Industrie Chimiche Italiane Petroli	Mantau, Italy	Crude Ref.	4,500 bbls.	.....	Contracted	Aug., 1952	.....	Koch	Staff
Industria Petrolifera e Chimica	Milam, Italy	Gasoline Fuel Oil Plt.	20,000 bbls.	.....	.....	.....	.....	Dr. Calogero Inglogio	.....
Industria Raffinazione Olii Minerali (IROM)	Porto Marghera, Italy	Crk. equipment	4,000 bbls.	$2 million	Planning	.....	.....	.....	.....
Imperial Chemical Industries, Ltd.	Wilton, Yorkshire, England	Petroleum Cracking Unit	2,000 bbls.	.....	Under Constr.	1951	.....	Kellogg	Kellogg
I. P. S. A.	Rotkreuz, Switz.	Cat. Reformer	.....	.....	Under Constr.	Jan., 1952	Phillips	Koch	Staff
L'Alliance Petrolina	Antwerp, Belg.	Refinery	21,000 bbls.	.....	Planned	.....	.....	.....	.....

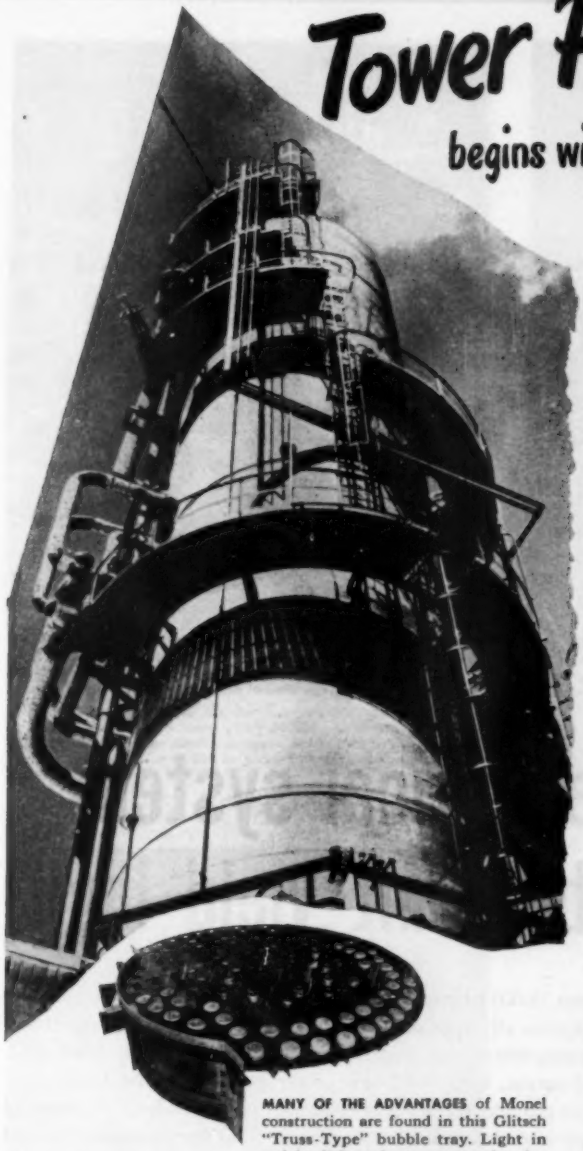
REFINERY AND OTHER PLANT CONSTRUCTION—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
Manchester Oil Refinery, Ltd.	Partington, England	New Lube Refinery	30,000 bbls.	.....	Projected	.....	.....	.....	.....
Mineralöel-und Asphaltwerke, A.G.	Ostermoor, Germany	Reconstruction	1,196 bbls.	.....	.....	.....	.....	.....	.....
Monsanto Chemical Co.	Britain	Add Poly-styrene	.....	.....	Under Constr.	1951	.....	Staff	Staff
Montecatini Co.	Ferrara, Italy	Olefin Plt.	450 bbls.	$18.6 million	Contracted	Mid 1953	.....	Kellogg	Kellogg
National Oil Refineries, Ltd	Llandarcy, Wales	Vacuum Unit	17,000 bbls.	.....	Under Constr.	End, 1951	.....	Badger	Badger
N.O.R.	Llandarcy	Propane Deasphalting	3,500 bbls.	.....	Under Constr.	End, 1952	J.U.I.K.	Badger	Badger
N.O.R.	Llandarcy	Furf. Ext.	1,250 bbls.	.....	Under Constr.	End, 1952	Texaco	Badger	Badger
N.O.R.	Llandarcy	M.E.K. Dewaxing	1,700 bbls.	.....	Under Constr.	End, 1952	Texaco	Badger	Badger
N.O.R.	Llandarcy	SO$_2$ Kerosene Ext.	2,000 bbls	.....	Under Constr.	1951	.....	H.W.P.	Staff
National Oil Refineries, Ltd	Llandarcy, Wales	Additional Boilers	.....	.....	Under Constr.	1952	.....	Ewbank & Partners	.....
N.O.R.	Llandarcy	Generating Plant	13,000 KW	.....	Authorized	1952	.....	Ewbank & Partners	.....
N.O.R.	Llandarcy	Cat. Crk.	10,000 bbls.	$48 million	Under Constr.	Early 1953	.....	Kellogg	Kellogg
A/S Norsk Amerikansk Mineraloljekompagni	Vallo, near Tonsberg, Norway	Lube Oil, Asphalt	1,000 bbls.	.....	.....	.....	.....	.....	.....
Pechelbrona, S.A. E. M.	Merkwiller, France	Capacity Increase	1,550 bbls.	.....	Authorized	1951	.....	.....	.....
Permolio, S.P.A., Raffinerie Italiane Olii Minerali	Genoa, Italy	Cat. Cracker	1,620 bbls.	.....	Planning	4th Qtr., 1951	.....	Foster Wheeler	Foster Wheeler
Permolio, S.P.A.	Milan, Italy	Perco Reforming Unit	350 bbls.	.....	Planning	1951	.....	.....	.....
Permolio, S.P.A.	Rome, Italy	Cat. Cracker	1,620 bbls.	.....	Planning	4th Qtr., 1951	.....	Foster Wheeler	Foster Wheeler
Petrochemicals, Ltd.	Partington, England	Petrochemicals	2,000 bbls.	$16 million	Under Constr.	1951	Petrocarbon	Petrocarbon	Petrocarbon
Raffinerie Belge de Petroleos, S.A.	Antwerp, Belg.	Topping Unit	8,000 bbls.	$1,000,000	Contracted	Sept., 1951	.....	H.W.P.	Chaurobel
Raff. Belge	Antwerp, Belg.	Atmos., Vac. Distill.	7,000 bbls.	$1.5 million	Planning	1951	.....	.....	.....
Raffineries Francaises de Petrole de l'Atlantique	St. Nazaire, France	Consolidate Refineries	7,100 bbls.	$9.4 million	.....	.....	.....	Separator-Nobel	.....
Raffineries Francaises	Paris	Thermal Reformer	4,500 bbls.	.....	Under Constr.	Jan., 1952	.....	Koch	Koch
Raffinerie Siciliane Olii Minerali, Sp.A.	Augusta, Sicily	Crude Refinery	10,000 bbls.	.....	Under Constr.	1951	U.O.P.	U.O.P., Delta, Staff, Separator-Noble	Staff
Refineria de Petroleos de Escombreras, SA. (REPESA)	Escombreras Spain	Four cell induced draft cooling tower	.....	.....	Under Contract	1951	.....	.....	Foster Wheeler
REPESA	Escombreras, Spain	Refinery Atmos. Dist., Lube Plt.	30,000 bbls.	$20 million	Under Constr.	Mid 1952	.....	Foster Wheeler	Foster Wheeler
REPESA	Escombreras	Thermal Reformer: Poly Cat.	6,400 bbls.	$2 million	Contracted	Feb., 1952	U.O.P.	McKee	Staff
REPESA	Cartagena, Spain	Lube Plt.	1½ mil. tons/yr	.....	Projected	.....	.....	.....	.....
Ruhrchemie, A.G.	Oberhausen-Holten, Germ.	Crude Refinery	6,000 bbls.	.....	Under Constr.	Mid 1952	.....	Koch	Koch
S.A. Conc. Ref. Pet. em Portugal	Cabo Riuvo Plt., Portugal	Topping Unit	10,000 bbls.	.....	.....	.....	.....	.....	.....
S.A. Conc. Ref. Pet. em Portugal	Cabo Riuvo Plt., Portugal	Cracking Unit	5,000 bbls.	.....	.....	.....	.....	.....	.....
S.A. Conc. Ref. Pet. em Portugal	Cabo Riuvo Plt., Portugal	Reformer	2,500 bbls.	.....	.....	.....	.....	.....	.....
Scottish Oils	Grangemouth, Scotland	Stage II: Cat. Crk., Gas Rec. Vac. Distill., Cat. Poly Plt., & Tring Plt.	37,700 bbls.	$52 million	Under Constr.	Mid., 1952	.....	.....	.....
Shell Chemical Mfg. Co., Ltd.	Stanlow, Eng.	Teepol Plant Extension	75,000 tons per year	.....	Under Constr.	Spring, 1952	.....	.....	.....
Shell Refining & Marketing Co., Ltd.	Shell Haven, England	Reforming Unit	†10,000 bbls.	.....	Under Constr.	1951	.....	.....	.....
Shell R. & M.	Shell Haven, England	Feed Prep. Plt.	†16,000 bbls.	$34 million	Under Constr.	.....	.....	.....	.....
Shell R. & M.	Stanlow, Eng.	Comprehensive Refining	60,000 bbls.	.....	Under Constr.	Early 1952	.....	.....	.....
Shell Union Oil	France	Wharf, tankage detergent, Acetone-Syn Iso-Propyl Plts	.....	$6 million	Completed	Late 1951	.....	.....	.....
Societe Generale Des Huiles de Petrole	Dunkirk, France	Crude Reform.	33,000 bbls.	$38,105,600	Completed	1951	Lummus, Kellogg	Lummus, Kellogg	Lummus, Kellogg
Societe Generale	Dunkirk, France	Furf. Ref. Sol. Dewax., Wax Fracto.	2,400 bbls.	.....	Completed	1951	Texaco	Lummus	Lummus
Societe Industriel Belge des Petrole	Antwerp, Belg.	Crd. Crk. Ref.	30,000 bbls.	.....	Under Constr.	1951	.....	Kellogg	Kellogg
Societa per l'Industria del Petrolio	La Spezia, Italy	Expansion	30,000 bbls.	.....	Under Constr.	Mid. 1952	.....	.....	.....
Societa per Azionai Raffineria Padana Olii Minerali	Milan, Italy	Refinery	10,000 bbls.	$20 million	Planned	.....	.....	.....	.....
Societe per Azioni Raffineria Padana Olii Minerali	San Martino di Trecate, Italy	Refinery	13,000 bbls.	$15 million	Under Constr.	Fall, 1952	.....	Badger	Badger
Societe Raffinazione Olii Minerali (IROM)	Porto Marghera, Italy	Atmospheric & Vac. Distill., Acid Treat., Contract Filtration for Lube Oils, Electric Gen. Unit, Load Facilities	11,600 bbls.	$6.4 million	Contracted	.....	.....	.....	.....
Socony-Vacuum Francaise	Frontignan, France	T.C.C. Unit	.....	.....	Planning	.....	Socony-Vacuum	.....	.....
Socony-Vacuum Francaise	Notre Dame de Gravenchon	MEK Unit	1,000 bbls.	$6 million	Under Constr.	1951	Texaco	Lummus	Staff
Socony-Vacuum Francaise	Notre Dame de Gravenchon	Grease and Compounding	900 lbs.	.....	Under Constr.	1951	.....	Staff	Staff

■ Table continued on page 102

In designing for all types of crudes...

Tower Protection begins with Monel!



MANY OF THE ADVANTAGES of Monel construction are found in this Glitsch "Truss-Type" bubble tray. Light in weight, it is easier to erect and maintain. Monel's ductility eliminates breakage during installation and cleaning... Smooth, corrosion-resistant Monel surfaces increase tower efficiency, reduce coking hazards. And Monel caps and trays, if distorted by explosion, can be readily straightened and restored to service... *This photo used through courtesy of the fabricator, Fritz W. Glitsch & Sons, Dallas, Tex.*

Design engineers seldom know, these days, what the next crude will be like.

Today sweet—tomorrow sour. Or maybe a mixture of both. That's why top sections of fractionating towers need *plenty* of protection against corrosion.

And they get this protection from MONEL*. That has been proved time and again in every refining center.

Just recently, for example, The M. W. Kellogg Company, refinery and chemical engineers of Jersey City, New Jersey, designed a large refinery for charging a sour crude containing in the neighborhood of 2% sulfur. Kellogg knew from past experience that most commercial metals used in the top sections of the fractionating vessels would pit due to corrosive action by sulfur and salt compounds in condensed water vapor.

Consequently Kellogg engineers recommended Monel-lined nozzles for refluxing in top tower sections for temperatures of 400°F. or below. Monel does not pit under these conditions, and Kellogg knew it would display satisfactory resistance to predicted corrosion in the upper tower sections where temperatures below the dew-point are encountered.

Monel, as a matter of fact, is highly resistant to sulfur attack at temperatures up to 500° F. It resists corrosion by sulfuric acid, dilute hydrochloric acid, brines, sour crudes, caustics and chlorinated solvents. Its high strength and low corrosion rate make possible the use of thin, lightweight sections that save you money in both material cost and tower design.

Right now, of course, INCO Nickel Alloys are diverted more and more to defense production. That's why you may have to wait for the Monel you want.

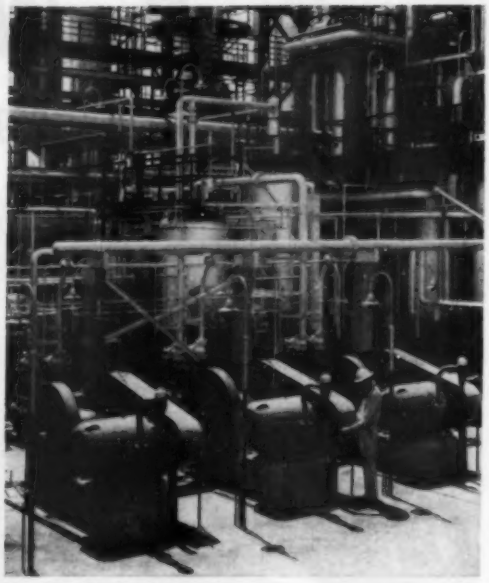
THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y. *Reg. U. S. Pat. Off.

EMBLEM OF SERVICE INCO TRADE MARK

MONEL...for minimum maintenance and replacement

A PHOTO-REPORT ON MODERN

1 **ONE FEATURE** of the Oleum refinery is its Duo-Sol extraction unit, used in the manufacture of lubricants. Pumps used in this process are driven by these G-E 2300-volt and 220/440-volt totally enclosed vertical motors rated from 20 hp. to 125 hp. Capacity of the unit is 6000 barrels per day.



2 **COMPRESSOR UNITS** in the Duo-Sol process section are driven by these three G-E 100-hp 2300-volt motors. Because of their corrosion-resistant totally enclosed fan-cooled construction, they are well suited to refinery conditions, regardless of the type of acids, alkalis or solvents encountered.

Co-ordinated electrical system helps keep lube-plant yield high!

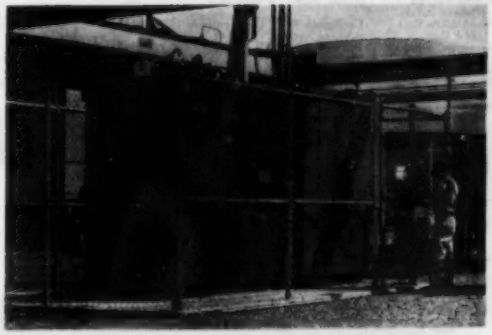
Engineered G-E drives and power distribution equipment assure needed reliability at Union Oil Company's refinery in Oleum, California.

From 75,000 barrels per day of crude, Union Oil's Oleum refinery processes all types of lubricating oils, plus gasoline, diesel oil, greases, refined wax, and other products. To maintain this diversified output, General Electric power-distribution and drive equipment provides the dependable electric power needed. Co-ordinated from start to finish, this installation is further proof that General Electric can meet all *your* refinery's electrical needs. Ask your G-E representative to give you the facts. General Electric Co., Schenectady 5, N. Y.

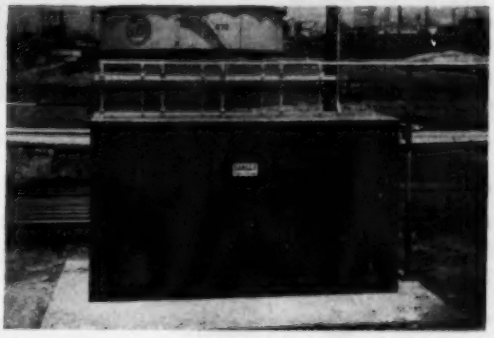
GENERAL ELECTRIC

661-27

3 PROCESS CONTROL for the Duo-Sol extraction unit is centralized in this pressurized and vapor-proof building to permit the use of standard non-explosion-proof equipment. Shown here are G-E limitamp motor-starters rated up to 350 hp and a Trumbull switchboard for controlling small motors.



5 FOR LOW-VOLTAGE NEEDS, this G-E outdoor-type 500-kva load-center substation steps down 2400-volt power to 480 volts close to where it's needed, cutting voltage drop and power losses. Complete and co-ordinated, these G-E metal-enclosed units are factory-built for quick installation.



6 CONTROL OF HIGH-VOLTAGE MOTOR and short circuit protection are both provided by this G-E outdoor-type limitamp assembly, serving a transfer pump house. Current-limiting fuses in limitamp controllers cut off current fast when a short occurs, protecting equipment against extensive damage.

4 PROTECTION against complete plant shutdown is part of the job for this incoming line G-E metal-clad switchgear assembly with dual feeders.

Co-ordinated
ELECTRIC EQUIPMENT
for lubricating-oil and solvent extraction

REFINERY AND OTHER PLANT CONSTRUCTION—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
Socony-Vacuum Italiana, S.P.A.	Naples, Italy	Visbreaker	.....	.....	.....	1951	.....	Staff	Staff
South Africa Coal Oil & Gas	Coalbrook, Orange Free St.	Coal Synthesis Plant	3,500 bbls.	$50.4 million	Under Constr.	1955	.....	Kellogg	Kellogg
Stanic Industria Petrolifera	Leghorn, Italy	Ref. Expan.	13,000 bbls.	.....	.....	End 1953	.....	.....	.....
Stanic Ind. Pet.	Bari, Italy	Modernization	12,000 bbls.	.....	.....	1952	.....	.....	.....
Standard Francaise des Petroles	Port Jerome, France	Dewaxing Plant	1,200 bbls.	$6.4 million	Design	End 1951	.....	S.O.D.	Foster Wheeler
Standard Francaise des Petroles	Port Jerome, France	Desophalting Plant	1,800 bbls.	.....	Design	End 1951	.....	S.O.D.	.....
Standard Francaise des Petroles	Port Jerome, France	Cat. Crk.	10,000 bbls.	$10 million	Authorized	March, 1953	.....	.....	.....
Standard Oil (N.J.)	Belgium	Dist. Crack	33,000 bbls.	.....	Planned	Early 1952	.....	.....	.....
Standard-Vacuum Ref. of South Africa	Wentworth, Durban, Union of S. Africa	Refinery	15,600 bbls.	$17 million	Begin 5/52	Late 1953	.....	Foster Wheeler	Foster Wheeler
Trent Oil Prod. Development Co.	North Shields, England	Crude Plant	11,500 bbls.	$4.8 million	Plans approved	.....	.....	.....	.....
Union Petrol Refinery, Ltd.	Johannesburg, Union of South Africa	New Refinery	.....	$20 million	Projected	.....	.....	.....	.....
Vacuum Oil Co., Ltd.	London, Eng.	Oil Refinery	8.3 mln. bbls./yr.	$28 million	Planning	.....	.....	.....	.....
Vacuum Oil Co., Ltd.	Birkenhead, England	Grease Plt.	.....	$1 million	Contracted	Early 1952	.....	H.W.P.	H.W.P.
Vacuum Oil Co.	Coryton, Eng.	Lube Refinery	17,000 bbls.	$30 million	Under Constr.	Sept., 1952	.....	.....	.....
Near East									Staff
*Caltex	Sidon, Lebanon	Diesel, Fuel Oil Plt.	13,000 bbls.	$5.8 million	Plan	Fall, 1953	.....	.....	.....
Consolidated Ref., Ltd.	Haifa, Palestine	Gen. Facilities Conversion of Kellogg Comb-Top. and Crk.	35,000 bbls.	.....	Planned	1951	.....	Badger	.....
Iraq Government	Baghdad Area	Refinery	24,000 bbls.	$19.6 million	Planning	Spring, 1954	.....	Kellogg	Staff
*Israeli Government	Haifa, Palestine	Petro Chem Plt.	10 tons	$2.5 million	Under Constr.	.....	.....	.....	.....
Turkey Government	Ramanding Field	Refinery	3,000 bbls.	$3.5 million	Planning	.....	.....	.....	.....
Far East									
Bataafsche Pet. Mij. (Shell)	Balikpapan, Borneo, East Indies	Expansion	80,000 bbls.	.....	Under Constr.	1951	.....	.....	.....
Bataafsche Pet. Mij.	Pladjoe, Sumatra	Rehad. to Comprehensive Refg.	71,000 bbls.	.....	Under Constr.	Early 1952	.....	.....	.....
Bataafsche Pet. Mij.	Tjepu, Java	Rebuild TEL Blending Unit & Dist. Unit	.....	.....	Planning	.....	.....	.....	.....
Burmah Oil Co., Ltd.	Syriam, Burma	Furf. Sol. Dewax., Wax Mfg	1,000 bbls.	$600,000	Designing	.....	Texaco	Badger	.....
Burmah Oil (Rangoon)	Chaukfield, Burma	2 Stage Distillation & Related Fac.	3,000 bbls.	Salvage	Under Constr.	Dec., 1952	.....	Staff	Staff
KOA Oil Co., Ltd. (and) Caltex Oil Co., Ltd	Marifu, Japan	Expansion of Vac. Unit, Contact Rerun Unit	Restricted to 3,000 BPCD	.....	Under Constr.	1951	.....	Tatsumi	Tatsumi
Koa Oil Co., Ltd.	Marifu, Japan	Solvent Dewaxing Plt.; Solvent Extracting Plt.	.....	.....	Design	1951-1952	.....	.....	.....
Mitsubishi Oil Co., Ltd.	Tokyo, Japan	Vacuum Distillation Unit	2,000 bbls.	.....	.....	1951	.....	.....	.....
Mitsubishi Oil	Tokyo, Japan	Solvent Extraction & Dewaxing Processes	.....	.....	.....	.....	.....	.....	.....
Nippon Oil Co., Ltd.	Yokohama, Japan	Benzene-Ketone Dewaxing-Deoiling Unit	.....	.....	.....	.....	.....	.....	.....
Nippon Oil	Kudamatsu, Japan	Benzene-Ketone Dewaxing-Deoiling Unit	.....	.....	.....	.....	.....	.....	.....
Nippon Oil	Japan	Lube Oil Refining	.....	.....	Under Constr.	.....	.....	Separator-Noble	.....
Toa Nenryo Kogyo K. K.	Wakayama, Japan	Propane, Dewaxing	1,200 bbls.	.....	Under Constr.	Oct., 1952	.....	S.O.D.-Staff	Staff
T. N. K.	Wakayama	Phenol Ext.	1,720 bbls.	.....	Under Constr.	Oct., 1952	.....	S.O.D.-Staff	Staff
Oceania									
Australian Shell	Clyde, New South Wales	LVI Lube Oil	250 bbls.	$620,000	Under Constr.	Sept., 1951	.....	.....	.....
Australian Shell Oil Co.	Geelong, Victoria, Australia	New Refinery	16,000 bbls.	$4.8 million	Under Consid.	Late 1954	.....	.....	.....
Australian Shell	Geelong, Victoria, Australia	Bitumen and Luboil Plant	.....	$10 million	Projected	Late 1953	.....	.....	.....
Australian Shell	Geelong, Victoria, Australia	Asphalt, Lube Sol. Extct Plt.	.....	.....	Projected	Late 1953	.....	.....	.....
Australian Shell	Melbourne, Australia	New Refinery	22,000 bbls.	.....	Under Constr.	Fall, 1953	.....	.....	.....
*Vacuum Oil	Altona, Australia	Refinery	14,000 bbls.	$17 million	Under Constr.	.....	.....	.....	Staff

* First appearance in tabulation. † Added capacity.

NOTE: Austin—Austin Co. Badger—E. B. Badger & Sons. Barnes—W. M. Barnes & Co. Betchel—Betchel Corp. Blaw-Knox—Blaw-Knox Construction Co. Braun—C. F. Braun Co. Breda—Breda Co. of Milan. Brown & Root—Brown & Root Construction Co. Cabot Eng.—Cabot Engineering. Can Kellogg—Canadian Kellogg Co. Cat Constr.—Catalytic Construction Co. Chemico—Chemical Construction Co. C. B. & I.—Chicago Bridge & Iron Works Co. Consd. Eng.—Consolidated Engineering Co. Delta—Delta Engineering Corp. Dresser—Dresser Engineering Corp. Elsaco—Elsaco Services, Inc. E & A—Ehrhart & Arthur, Inc. Esso Eng.—Esso Engineering Corp. Fletcher—Fletcher Oil Co. Fluor—Fluor Corp. Foster Wheeler—Foster Wheeler Corp. Graff—Graff Engineering & Equipment Co. Grebe & Doremus—Grebe & Doremus Process Co. Houdry—Houdry Corp. Huber—J. M. Huber Corporation Hudson—Hudson Engineering Corp. H. W. P.—Head Wrightson Process, Ltd. Hydrocarbon—Hydrocarbon Research, Inc. J. & L.—Jones & Laughlin Supply Co. Kellogg—The M. W. Kellogg Co. Kellogg P. A.—Kellogg Pan-American. Koch—Koch Engineering Co. Koppers—Koppers Co., Inc. Knowles—Morris Knowles & Co. Lummus—The Lummus Co. McKee—Arthur G. McKee Co. O. L. Olson. P. A. Hydro Res.—Pan American Hydrocarbon Research Co. Parsons—The Ralph M. Parsons Co. Perco—Div. Phillips Petroleum. Petco—Petroleum Engineering Tool Co. Petrocarbon—Petrocarbon Ltd. Phillips—Phillips Petroleum Co. Pioneer—Pioneer Industrial Co. Pritchard—J. H. Pritchard Co. Pro Eng—Process Engineers, Inc. Process Constr—Process Construction Co. Ref Eng.—Refinery Engineering Co. Ref Maint—Refinery Maintenance Co., Inc. Schneider—Schneider & Cie. Socony-Vac—Socony Vacuum Oil Co. SOD—Standard Oil Development Co. Stearns-Roger—Stearns-Roger Manufacturing Co. Stone & Webster—Stone & Webster Construction Co. Sunland—Sunland Refining Co. Sweco—Southwestern Engineering Co. Tatsumi—Tatsumi Engineering Co. Tellepsen—Tellepsen Construction Co. Texaco—The Texas Co. UOP—Universal Oil Products Co. Walker—P. J. Walker Co.

It's new... so it's MARLEY!

MARLEY
Laminated Fan Cylinder
PATENT APPLIED FOR
THE MARLEY CO., INC.
KANSAS CITY KANSAS

Cooling Tower Fan Cylinders

that are entirely new, distinctive in design . . . are another major addition to Marley's long list of achievements in cooling tower advancement.

Laminated Fan Cylinders are the sturdiest ever applied to cooling towers. Built entirely of overlapping layers of redwood boards, they are structurally strong . . . uniformly strong at every point. No metal shape rings or clamp strips are needed; there is nothing to corrode, loosen or vibrate. Laminated Fan Cylinders are built of the same material as the towers they serve . . . built to last as long.

MODERNIZE ANY LARGE INDUCED DRAFT TOWER

Laminated Fan Cylinders will reduce maintenance time and upkeep expense on any large cooling tower. No painting, no replacing rusted metal parts — you check fan cylinders off the maintenance list when you install modern Laminated Fan Cylinders. Engineers have ordered many of these fan cylinders for replacement since Marley recently made them available.

also producers of
DOUBLE-FLOW TOWERS
CONVENTIONAL TOWERS
DRICOOLERS
NATURAL DRAFT TOWERS
SPRAY NOZZLES

For detailed information, call your Marley representative or write for LP-30a.

The Marley Company, Inc.
KANSAS CITY 15, KANSAS

MARLEY

The most widely used high temperature block insulation for over a quarter century...

SUPEREX® high temperature block insulation has long been industry's No. 1 choice for service temperatures up to 1900F. It provides *major* economies . . . reduces fuel costs, cuts heat losses, keeps maintenance expense down, costs less to install and has long service life.

Made of specially selected and calcined diatomaceous silica blended with other insulating materials and bonded with asbestos fiber, Superex will safely withstand temperatures up to 1900F with negligible shrinkage.

Superex has been used with outstanding success in all types of ovens, stationary and marine boilers, auxiliary power plant equipment, stills, reactor chambers, regenerators, high temperature mains, heaters, flues, stacks, and other types of high temperature equipment.

Superex has all these important advantages...

Low thermal conductivity—Exceptionally high heat resistance (1900F) combined with excellent insulating value.

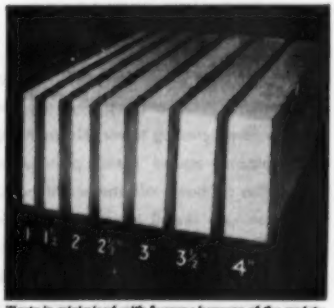
Light weight—Approximately 2 lb per sq ft per in. thickness.

Great physical strength—Approximately 6 tons pressure per sq ft are required to compress Superex ½ in.

Long, efficient service life—Superex maintains high insulating value indefinitely—will not disintegrate in the service for which it is recommended.

Fast, easy application—Superex may be cut with an ordinary knife or saw for fitting around openings or to irregular surfaces. Because of its light weight and convenient sizes, Superex assures fast and economical installations.

For complete information about Superex block insulation, write for Brochure IN-134A. Address Johns-Manville, Box 290, New York 16, N. Y. In Canada, write 199 Bay Street, Toronto 1, Ontario.



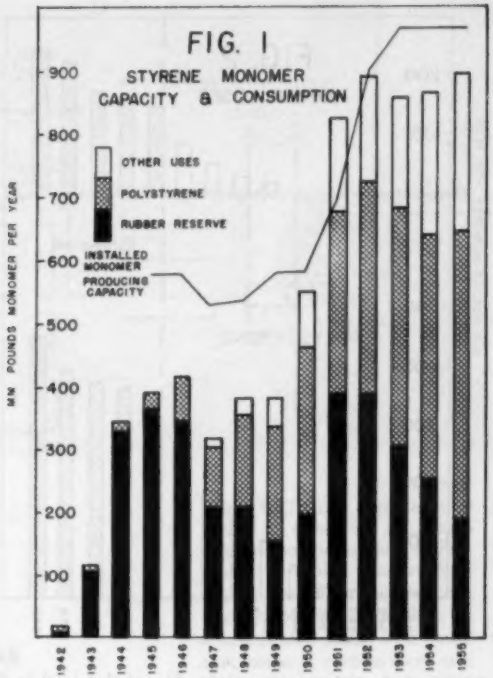
Waste is minimized with Superex because of the variety of thicknesses available. Special shapes and intermediate thicknesses between those shown are also available.

Johns-Manville *first in* INSULATIONS

PETROLEUM
REFINER
OCTOBER, 1951

Saturation Seen In Styrene Demand

A STAFF PETROCHEMICAL MARKET REPORT



THE CRUX of the availability of styrene monomer lies in the politically sensitive requirements of the synthetic rubber program for national defense. Synthetic rubber production, in turn, is influenced strongly by the unstable behavior of natural rubber price and availability. Despite the claims to the contrary, rubber producers decline to predict an all-synthetic rubber era in the near future. Although non-rubber end-uses of monomer are growing steadily, total demand can be expected to reach a plateau very shortly because of reduced defense requirements. With present producers expanding to nearly 145 percent of the 1951 capacity, styrene monomer supply should become more plentiful than ever before for private end-uses.

Petroleum people, because of their importance as suppliers to the monomer industry, should become aware of the forces that tend to regulate the consumption pattern for styrene monomer.

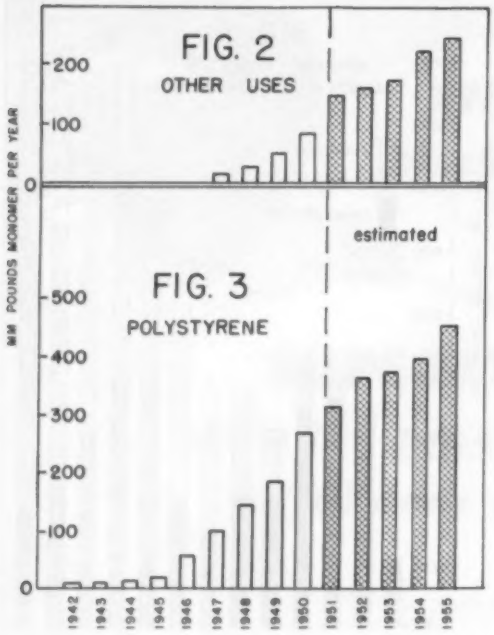
THE demand for styrene monomer, since the outbreak in Korea, has stimulated interest among petroleum refiners. Styrene is produced by a series of chemical operations on benzene and ethylene, and refiners are increasing their capacities for both of these raw materials. Present producers of monomer are rapidly increasing their facilities to meet the styrene demand. Announced expansions will swell styrene monomer producing capacity close to the 1 billion pound-per-year mark by 1955.

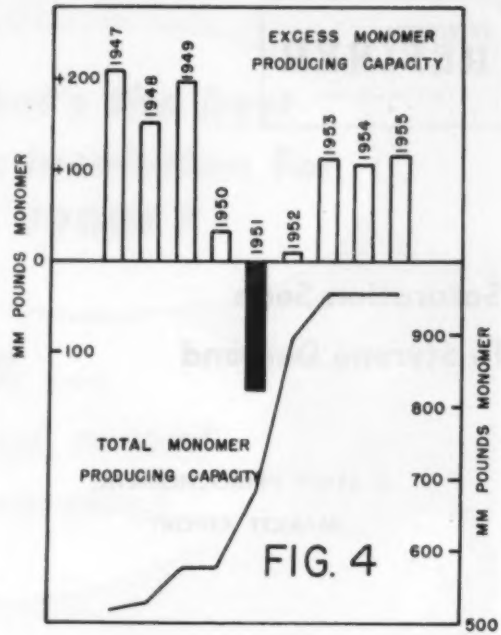
The questions in point: How long will demand continue to exceed installed capacity? Is the projected capacity adequate?

Demand Picture

Excepting a short period during 1949, well over half of the styrene monomer produced has been consumed by the Office of Rubber Reserve in the copolymerization of styrene with butadiene to form GR-S. Since the close of World War II natural rubber production has steadily increased. Although the price of natural rubber tended downward, the commerce provided dollars to a large section of the Far East. GR-S production has been subject to fluctuations inherent in the role of a buffer to facilitate the stockpiling of natural rubber when such availability became unfavorable.

Immediately after World War II, ORR drain on monomer was throttled down by the orderly closing of GR-S plants. That recession in GR-S production released monomer for the fledgling polystyrene molding powder industry which launched its expansion program. By 1947 enough monomer was available to support the growth of other styrene end-uses, such as alkyd-resins, polyester contact resins, ion exchange resins, shoe soles and heels, styrenated paints, and floor tile. Before these potential end-users could establish stable growth patterns, a styrene monomer squeeze was on. Benzene supply was painfully short during late 1949 and early 1950, and petroleum refiners were called upon to supplement imports and to improve the long term supply situation. Even though installed capacity for styrene monomer was more than adequate, lack of benzene created an artificial sellers' market. The coming of the Korean War made that situation a real one when Rubber Reserve reopened their co-polymer plants during the last half of 1950. During May of 1950, Rubber Reserve required only 27 percent of the total private production of styrene monomer. By May, 1951, that





preempted portion was up to 41 percent.

For some time now, private end-use requirements for styrene monomer have not been satisfied, and end-use facilities have been idle. Not withstanding the easing of the benzene shortage, heavy demands by Rubber Reserve forced resin manufacturers, already with idle equipment, to curtail any plans for expansion.

A cursory examination of the total demand level for 1951, as shown in Figure 1, would indicate a shortage of styrene capacity. Predicted growth patterns in polystyrene and others for the years 1951-55, as shown in Figures 2 and 3, imply a continued need for more monomer capacity. However, a closer consideration shows how much of the total consumption during 1951 is based on Rubber Reserve requirements. Commitments to Rubber Reserve are greater for 1951 than during any year previous. Nothing, short of total war, can maintain such a level.

At the end of World War II, GR-S production was drastically reduced to make way for more natural rubber influx. The impending cutback in GR-S production is anticipated to be more gradual, but equally as certain. Production of GR-S is expected to hold firm in 1952—to drop to three-fourths of that level in 1953—to two-thirds in 1954—and to one-half by 1955. The assumed 1955 rate is 145 percent of the rate during the lowest quarter in 1949—and 180 percent of the minimum level of production set out in the Rubber Act of 1948.

Based on that rate of decline, total demand for styrene monomer reaches a level in 1955 only 10 percent higher than the 1951 demand. (See Figure 1.) This softening of total demand is indicated in spite of an expected 45 percent rise in polystyrene usage, and an expected 65 percent rise in other usages—over the same period, 1951 to 1955. These anticipated growth rates are consistent with the rates exhibited when styrene monomer was available, and are based on projection methods employing the Federal Reserve Board Index.

Also pertinent to any evaluation of future demand for styrene monomer, but not weighted here, is the trend of styrene content in GR-S. Over the past ten years the styrene monomer content of GR-S has dropped from 23 to 18 percent—representing approximately one-fifth less monomer than before. Experimental work is under way to reduce further and/or substitute the styrene ingredient. As this trend progresses, styrene now required in GR-S will become available for other end-uses.

Supply Picture

The government has maintained ownership of one styrene monomer plant, the capacity of which is being expanded. In addition, four major chemical companies are now producing styrene monomer in five plants. These five plants, which were built with a total rated capacity of 350 million pounds per year, are currently producing at a rate of approximately 610 million pounds per year, by simple bottleneck removal in exising production facilities.

Each of those producers has announced plans for immediate expansion. In view of the foregoing reasoning, those announced expansions are believed to be conservative. A realistic estimate of the present and the future total monomer producing capacity must take into account some factor of conservation known to be evident in all announced figures. The supply-demand picture based on conservative figures for monomer capacity and optimistic figures for styrene usage tends to show a continued sellers' market through 1955. However, a much different picture is apparent when more realistic evaluations are used. (See Figure 4.)

* * *

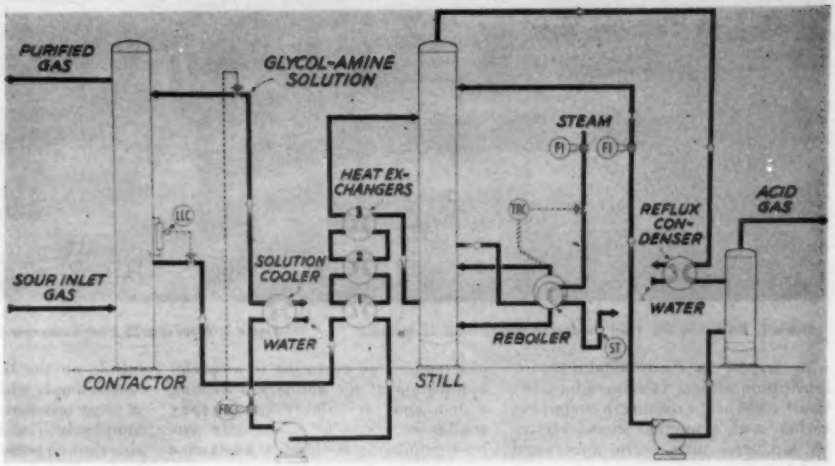


Figure 1. Typical Flow Sheet of Amine Gas Treating Process. (ST-Steam trap; FI-Flow Indicator; LLC-Liquid Level Controller; FRC-Flow Recorder Controller; TRC-Temperature Recorder Controller.)

Corrosion Resistance of Alloys In Amine Gas Treating Systems

F. C. RIESENFELD and C. L. BLOHM

The Fluor Corporation, Ltd.
Los Angeles, Calif.

IN PLANTS used for the removal of acidic constituents such as hydrogen sulfide and carbon dioxide from natural and other gases, corrosion of carbon steel equipment has constituted a major operating difficulty. This article will present a further discussion of corrosion difficulties encountered in gas treating plants using either aqueous or glycol-amine solutions, in particular, solutions of monoethanolamine in these combinations. The presentation will be confined to the application of the amine process as used in the large scale treatment of natural gas.

Both the aqueous and the glycol-amine processes have been described adequately in the literature[1, 2] and it is felt that no discussion of these processes is necessary. For reference to the various pieces of equipment which will be discussed in the following paper, the basic flow sheet of the amine gas treating process is presented in Figure 1. This flow diagram is essentially the same for both the aqueous and the glycol-amine system.

In view of the great importance of corrosion in the operation of amine gas treating plants, a comprehensive study has been conducted by this laboratory during the past three years. This investigation was conducted stepwise starting on a laboratory scale with small specimens of carbon steel and various ferrous and non-ferrous alloys which were exposed to amine solutions under different conditions. A small scale pilot plant simulating various parts of a commercial gas treating plant was subsequently constructed and, on the basis of the results obtained in the laboratory investigation, specimens of selected metals were tested in this equipment for their corrosion resistance to a typical glycol-amine solution containing approximately 15 percent of monoethanolamine, 80 percent of diethylene glycol and 5 percent of water. The results of this investigation were reported in a previous publication of the authors[3].

Since aluminum 2S and 3S and 4-6 Cr.-½ Mo. steel showed great promise

THIS ARTICLE completes a series of three by the same authors on the subject of corrosion in amine gas treating plants. The program was conducted step-wise, starting on a laboratory scale with small specimens of carbon steel and different alloys for possible use in treating plants. This initial work was reported in Petroleum Refiner, April, 1950, p. 141. The next step included corrosion experiments in small pilot units operated at field conditions, as reported in Petroleum Refiner, February, 1951, p. 97.

This presentation extends experience into the full scale application of aluminum and various ferrous alloys for the fabrication of such process equipment. In addition, there are presented some preliminary laboratory data on the corrosion of metals in an aqueous solution of methyldiethanolamine. Finally, the status of the present knowledge on corrosion problems in amine gas treating systems is reviewed and summarized. This paper was presented before the Petroleum Mechanical Engineering Conference of the American Society of Mechanical Engineers, Tulsa, September, 1951, but aside from possible ASME publication, it will be exclusive with Petroleum Refiner.

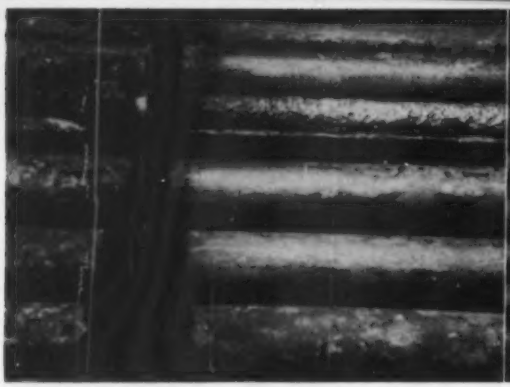


Figure 2. 4-6 Cr.-½ Mo. Heat Exchanger Bundle after 15 Months.

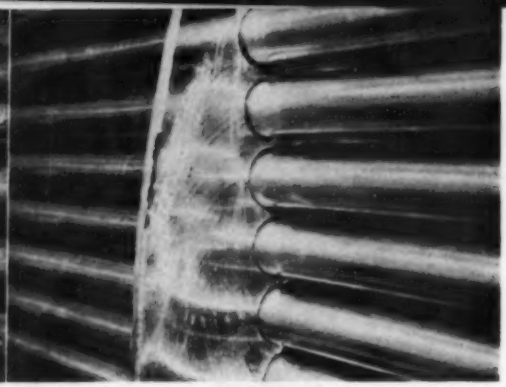


Figure 3. Aluminum 3S Heat Exchanger Bundle after 60 Days.

with respect to their suitability for fabrication of heat exchanger bundles, small scale heat exchangers containing carbon steel, aluminum 3S and 4-6 Cr.-½ Mo. steel tubes were constructed and tested on a slip stream of a commercial glycol-amine plant. At the same time, a small scale heat exchanger bundle containing various stainless steels, aluminum, Monel and Inconel tubes was also constructed and tested on a slip stream of a different glycol-amine plant. Since early results from the experiments with the small scale heat exchangers indicated the suitability of 4-6 Cr.-½ Mo. steel, a full size heat exchanger bundle was fabricated from this material and installed in the hottest pass of a glycol-amine plant. Carbon steel bundles in this plant had shown very severe corrosion and could only be operated for 60 to 90 days before tube failure. The results from the investigation using the small scale experimental heat exchangers were reported in a subsequent publication of the authors[4]. That paper also contained some information on the performance of the full scale 4-6 Cr.-½ Mo. bundle and discussed general corrosion difficulties encountered in glycol and aqueous amine treating plants. Specifically, reboiler corrosion in aqueous amine systems was discussed and some information regarding the use of alloys in this service was presented. Finally, it was attempted in that publication to summarize the most important factors influencing corrosion of carbon steel in both systems and to draw certain conclusions with respect to favorable and unfavorable design features in such plants.

Presented here is additional information obtained on the corrosion in amine gas treating systems since the last publication of the authors. It will deal with further experience on the use of full scale alloy bundles in heat exchanger and reboiler service and will discuss in addition corrosion in still columns and remedies therefor. Finally, there will be added some observations on corrosion in a special application of the amine gas treating system and preliminary laboratory studies on corrosion in treating systems employing methyldiethanolamine in place of the conventional monoethanolamine.

Heat Exchanger Corrosion

On the basis of the results obtained from laboratory and pilot scale work, a full size bundle containing 4-6 Cr.-½ Mo. tubes was manufactured and installed in the hottest pass of a glycol-amine plant. The bundle contained carbon steel tube sheets, baffles and spacers and besides the 4-6 Cr.-½ Mo. tubes, two tubes each of Monel and Inconel. The rich glycol-amine solution flowed in a single pass through the shell and the lean solution in two passes through the tubes. The bundle was inserted in a carbon steel shell and was operated at approximately the conditions shown in Table 1.

TABLE 1

Solution Composition	
Monoethanolamine	17.00 percent
Diethylene Glycol	77.00 percent
Water	6.00 percent
Acid Gas in Rich Solution	20 Volumes/Volume
CO_2:H_2S in Rich Solution	0.5:1
Temperatures	
Lean Solution to Exchangers	302° F.
Rich Solution from Exchangers	243° F.

The performance of this bundle after 146 days of operation was reported previously[4]. At that time, only very minor corrosion could be found on the 4-6 Cr.-½ Mo. tubes and practically no corrosion on the Monel and Inconel tubes. This bundle was inspected again after 15 months of continuous service, and the tubes showed no appreciable signs of corrosion, although the carbon steel baffles and tie rods were almost completely destroyed, as shown in Figure 2.

It is interesting to point out that carbon steel bundles operating in this heat exchanger corroded regularly after 60 to 90 days of service. These bundles showed a huge deposit of iron sulfide on the tubes which could be removed only with great difficulty and, in some instances, plugged the bundle completely. The 4-6 Cr.-½ Mo. bundle also showed some plugging after much longer periods of operation, but the deposit on the tubes could be removed with relative ease.

A heat exchanger bundle containing aluminum 3S tubes with aluminum 61-ST tube sheets, baffles and spacers was installed in another glycol-amine plant. This bundle was inspected after 60 days of operation and no corrosion whatsoever could be detected on the surface of the tubes. The tubes were covered with a thin black coating consisting of iron sulfide and some glycol-amine which could be removed very easily by hosing with hot water. The tube surface underneath the coating was very shiny and close inspection did not reveal any pits or other signs of corrosive attack on either the tubes or any other part of the bundle. A closeup of a section of this bundle is shown in Figure 3. The bundle was inspected again after 8.5 months and showed no detectable signs of corrosion. The general appearance of this bundle after the latter inspection was the same as indicated by Figure 3. Carbon steel bundles which had been used in this installation prior to the installation of the aluminum bundle could be operated for an average of seven months before replacement.

The operating conditions of the plant were approximately as shown in Table 2.

TABLE 2

Solution Composition	
Monoethanolamine	22.00 percent
Diethylene Glycol	71.00 percent
Water	7.00 percent
Acid Gas in Rich Solution	25 Volumes/Volume
CO_2:H_2S in Rich Solution	5:1
Temperatures	
Lean Solution to Exchangers	310° F.
Rich Solution from Exchangers	225° F.

Based on the results of the performance of this aluminum bundle, several other aluminum bundles had

Figure 4. Type 304 Heat Exchanger Bundle after 5 Months. Note holes near baffle.

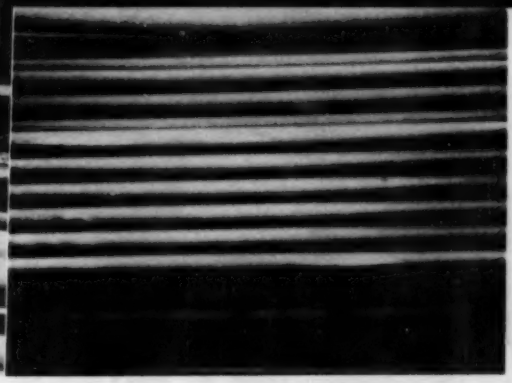


Figure 5. Aluminum 3S Reboiler Tubes in Carbon Steel Bundle after 35 Days.

been installed in various glycol-amine plants, some of which have been in operation for several months without difficulty being encountered.

Considerable corrosion of carbon steel heat exchangers had been encountered in a plant using a solution containing approximately 30 percent of monoethanolamine and 70 percent of water. This plant is operated on a nine-month cycle, being idle for the remaining three months of the year. It was found that during the operating period, rather severe corrosion of the carbon steel exchanger tubes was incurred but that by plugging leaky tubes it was possible to maintain carbon steel exchanger bundles in operation for the full nine months. All the corrosion was noticed on the outside of the tubes which contacts, in this installation, the lean or regenerated amine solution. The corrosion was general in all passes of the heat exchangers, being the worst, however, in the hottest pass. The appearance of the corrosion was that of deep pitting and general material loss. In order to alleviate this difficulty, it was attempted to use Type 304 stainless steel tubes in the hottest pass of the heat exchanger. These tubes corroded quite badly, in fact, at a higher rate than the carbon steel, and after five months a considerable loss of metal could be noticed. Large holes developed near the lean solution inlet and the bundle had to be taken out of operation after that period of time. Figure 4 presents a closeup of the Type 304 bundle near the baffle plate. In addition to the loss of tubes, definite signs of corrosion could be found on the carbon steel exchanger shell, baffles and tube sheets. This plant operated originally with a still pressure of 40 psig and a corresponding reboiler temperature of 270° to 280° F. In order to reduce the corrosion difficulty, the still pressure was lowered to 28 psig and the reboiler temperature accordingly to 250° to 260° F. As of this writing, no satisfactory solution of this corrosion problem has been found.

In one plant which uses a combination of monoethanolamine, diethylene glycol and water of a somewhat different composition than the typical glycol-amine plants, corrosion of carbon steel heat exchangers was observed after five months of operation. In this plant, the lean solution flows through one pass in the shell of the heat exchanger and the rich solution through two passes in the tubes. Upon inspection after five months of service, it was noticed that the tubes in all passes of the heat exchangers had corroded on the lean solution side and not much difference could be found in the corrosion between the hottest and the coldest exchanger passes, although no actual failures were observed. A rather large deposit of iron sulfide was found in all units and poor heat transfer was obtained as evidenced by low temperatures of the rich solution leaving the heat exchangers. This plant was operated under conditions shown in Table 3.

TABLE 3

Solution Composition	
Monoethanolamine	22.00 percent
Diethylene Glycol	38.00 percent
Water	40.00 percent
Acid Gas in Rich Solution	.33 Volumes/Volume
CO_2:H_2S in Rich Solution	0.3:1
Temperatures	
Reboiler	260° F.
Rich Solution from Heat Exchanger	165° F.

It is interesting to note that this plant, although it contains an appreciable amount of diethylene glycol, follows the corrosion pattern observed in aqueous rather than in glycol-amine systems. After the inspection at the end of five months operation, the heat exchanger bundles were placed back in service and at this writing, no tube failure has been reported.

In general, it is felt at this point of the investigation that aluminum 3S and 4-6 Cr.-½ Mo. steel are satisfactory materials for use in the manufacture of heat exchangers in glycol-amine plants. More expensive alloys such as Type 316 stainless steel, Monel, Inconel and Carpenter 20 may be suitable for use in aqueous amine systems in which, however, the principal corrosion difficulties have been encountered in reboilers. The life of carbon steel heat exchangers in such systems has varied from a few months to several years, depending on operating conditions. On the other hand, carbon steel bundles have been maintained in operation in the reboilers of glycol-amine treating plants for periods up to 40 months.

Reboiler Corrosion

The corrosion observed in reboilers of glycol-amine plants differs considerably from that occurring in aqueous amine systems. While in aqueous amine plants the reboiler is generally the place of the most active corrosion, relatively little corrosion has been noticed in reboilers operating in glycol-amine systems. The reason for this difference in behavior was discussed quite extensively in the two previous publications of the authors[3, 4]. In order to recapitulate, it might be stated briefly that in a glycol-amine system, practically all the stripping of acid gas occurs in the still column proper and only a very minor portion of the acid gas is evolved in the reboiler. In aqueous amine plants, the main part of acid gas stripping, particularly with respect to carbon dioxide, occurs in the reboiler. Since it is the authors' opinion that the presence of acid gas at high temperatures is mainly responsible for the observed corrosion, it can be concluded that aqueous amine reboilers are more subject to corrosion than those operating in glycol-amine plants.

In glycol-amine systems under proper operation, the solution leaving the still column and flowing to the reboiler should contain less than 0.5 volume of acid gas per volume of solution, and in some cases this may be as little as 0.1 volume per volume. This

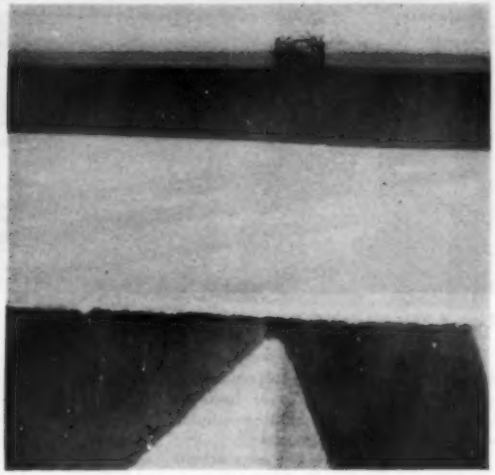


Figure 6 (above). Aluminum Reboiler Tubes after 35 Days Showing Localized Defect.

Figure 7 (right). Aluminum Reboiler Tubes after 82 Days Showing Corrosion underneath Support Plate.

acid gas, in most cases, consists almost entirely of carbon dioxide with only minor traces of hydrogen sulfide present. The lean solution leaving the reboiler usually contains 0.1 volume of acid gas per volume or less. The life of carbon steel reboilers in a considerable number of glycol-amine plants has varied from approximately 25 to 40 months, the first tube failure being taken arbitrarily as the failure point of the bundle. It should be understood that in most instances only a few tubes developed leaks at that time and that it was possible to operate the bundle by plugging leaky tubes for a considerably longer period of time before replacement became necessary. It was noticed that those reboilers which were operated at approximately 300° F. and with a solution flowing to the reboiler containing a minimum of acid gas performed best and it is estimated that by proper operating practice, a lifetime of 3½ to 4 years per bundle should be obtained. Although an attempt has been made, no direct correlation could be found between the acid gas composition, i.e., the ratio of CO_2 to H_2S, and the corrosion rate of carbon steel reboiler bundles. It is felt that the degree of solution deterioration due to oxidation and the presence of extraneous matter in the solution constitute aggravating factors in the corrosion behavior.

Since laboratory and full scale field experiments had indicated the suitability of aluminum alloys, especially aluminum 3S, for the manufacture of heat exchanger bundles, a study was conducted in order to determine the suitability of this material for reboiler service. Twelve aluminum 3S tubes Alcad in the inside, were inserted in a carbon steel bundle of a reboiler operating in a typical glycol-amine plant. Six of these tubes were placed in the top row and six in the bottom row of the bundle. The bundle consisted of carbon steel tube sheets, support plates and spacers besides the carbon steel tubes. This reboiler was operated in such a manner that the solution flowed in a single pass through the shell while steam flowed in two passes through the tubes. After 35 days of operation, the bundle was removed and the aluminum tubes examined. It was found that the aluminum tubes were covered by a relatively small amount of iron sulfide which increased towards the rich solution outlet. In that part of the bundle, some iron sulfide was quite tightly packed between the tubes and formed bridges between carbon steel and aluminum tubes. Near the solution inlet, the aluminum tubes were almost free from iron sulfide deposit and showed a bronze coloration which adhered quite tightly to the surface. This effect is demonstrated in Figure 5 which shows the six aluminum tubes installed in the top tube row. A number of rough spots could be found on the tubes and when the bronze covering was removed by scraping with a knife, the tubes showed definite roughness underneath this coating. Towards the rich solution outlet, the tubes were covered with a dark gray coating which also adhered quite tightly and could only be removed by scraping. In general, the side of the aluminum tubes facing carbon steel tubes showed roughening and some pitting and, in some instances, spots of blank metal varying in size from 1 to 2 square centimeters could be detected in the areas near the solution outlet. A portion of a tube removed from the top row showing such defect is presented in Figure 6. It is believed that these defects were caused by electrolytic action between the aluminum, the iron sulfide bridge and the carbon steel, or possibly by the so-called "poultice effect" of the precipitated iron sulfide. Some of the bronze coating of these tubes was removed and analyzed spectrographically, but the results of this analysis were inconclusive. Since these test tubes had been operated in a carbon steel bundle and the juxtaposition of carbon steel was thought to favor electrolytic action, it was decided to consider the results of this test as inconclusive and to proceed with the fabrication of a bundle containing carbon steel tube sheets, aluminum 3S tubes and spacers and aluminum 61-ST support plates. This bundle was tested in the same installation for a period of 82 days at substantially the same operating conditions. These conditions are shown in Table 4.

TABLE 4

Solution Composition	
Monoethanolamine	15.5 percent
Diethylene Glycol	76.4 percent
Water	8.1 percent
Acid Gas in Solution from Still to Reboiler	0.188 Volume/ Vol.
Reboiler Temperature	300° F.
Steam Pressure	92 Psig.

When the bundle was inspected, it was found that it was covered with a rather thin film of dirt consisting mainly of iron sulfide. A relatively small amount of iron sulfide deposit was found in the bottom of the reboiler shell. Close inspection of the aluminum tubes revealed that corrosion had occurred in the top row between the hot tube sheet and the first support plate. Three corroded spots could be distinguished on three tubes in the close vicinity of the hot tube sheet and signs of corrosion were also found near the first support plate. In the spaces between the support plates, the tubes appeared to be smooth and free from corrosion. Some tubes showed a bronze coloration on the surface which was quite similar to that observed on the aluminum tubes installed in the carbon steel bundle

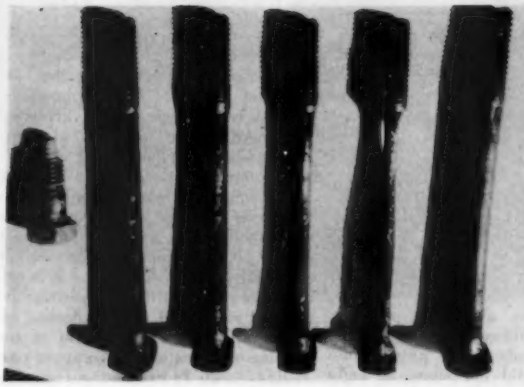


Figure 8. Cap Hold-Down Bolts from Still Trays, Left to Right, First above Feed, Feed and Three below. Also One Trayway Cover Bolt.

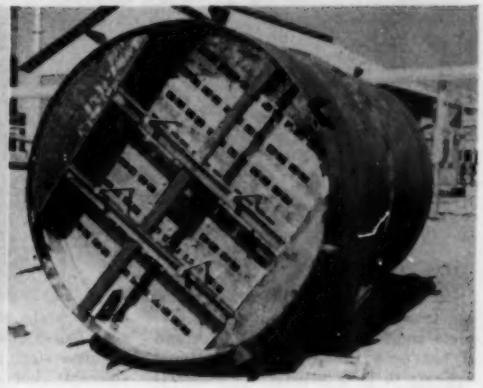


Figure 9. Aluminum-Lined Still Section with Aluminum Trays, less Caps.

previously used. One tube was removed from the top and one from the bottom row of the bundle, and it was found upon examination that corrosion had occurred underneath the support plates, the severest attack being evident under the first support plate. Figure 7 shows a tube removed from the top of the bundle with corrosion under the first support plate. A micrometer measurement of the tube removed from the bottom indicated a material loss of 0.006 inch under the first baffle.

Examination of the inside (steam side) of the tubes indicated that they had lost their bright luster and a definite longitudinal striation was noticeable. However, subsequent microphotographs of a sample of the 12 test tubes installed in the carbon steel bundle indicated that no material loss had occurred on the inside of the tubes. The outside of these tubes showed a reduction in wall thickness of approximately 0.012 inch.

After inspection, the aluminum bundle was put back in operation and after subsequent service of 120 days, the bundle was removed due to failure of a small group of tubes. These tube failures were probably caused by steam leakage through a loose roll at the tube sheet and subsequent steam cutting of the tubes immediately surrounding this leak.

Based on the results of this experiment, it is indicated that aluminum may not be a suitable material for the manufacture of reboiler bundles in glycol-amine plants. However, another full-scale bundle containing aluminum tubes but carbon steel tube sheets, baffles and spacers has been installed recently in a different plant and will be used for further observation in this service. Furthermore, it is planned to conduct similar full scale experiments with 4-6 Cr.-½ Mo. steel tubes.

In one plant operating with a glycol-amine solution containing a rather large amount of water, quite rapid corrosion of a carbon steel reboiler bundle was observed. The reboiler temperature of this plant was maintained for the first 13 months of its operation at approximately 290° F. and was subsequently lowered to 240° F. After 13 months of operation, leaks were detected and a number of tubes had to be plugged. Continuing corrosion made further plugging of leaky tubes necessary and after a total of 21 months of operation, the bundle had to be removed and replaced by a new unit. When inspected, it was found that very severe corrosion of the tubes had occurred in the close vicinity of and underneath the baffle plates. Sharp cuts and holes in the tubes were observed in these areas while in the area between the baffles, the tubes showed practically no corrosive attack. It was interesting to note that no concentration of this corrosive effect could be observed at any particular baffle, but a rather random distribution along the entire length of the bundle. At first it was thought that this failure might have been due to vibration of the tubes in the baffle holes and subsequent mechanical breakage. However, after closer inspection, it became evident that the phenomenon observed was most probably due to corrosion caused by stripping of acid gas in the reboiler. After initial corrosion which produced enlargement of the baffle holes, movement of the tubes might have acted as an aggravating factor. This unit was operated in such a manner that the solution flowed in one pass through the shell and the steam in two passes through the tubes. The solution entering the reboiler contained a considerable amount of acid gas and appreciable evolution of gas was occurring in the reboiler. It is quite interesting to note that this unit, although having been operated with considerable amounts of glycol present in the solution, followed rather the corrosion pattern observed in aqueous amine systems than in glycol-amine plants.

At this time, it is felt by the authors that carbon steel can be used economically for the manufacture of reboiler bundles in glycol-amine systems. With proper plant operation, carbon steel tube bundles can be expected to last approximately 3½ to 4 years which, in most cases, is considered satisfactory and more economical than the use of expensive alloys such as stainless steels, Monel or Inconel.

One more point worth mentioning might be that both kettle type and thermosyphon reboilers have been used in glycol-amine plants. It appears that thermosyphon reboilers perform somewhat more satisfactorily with respect to corrosion resistance of carbon steel tubes. In one instance, very little corrosion has been encountered in a thermosyphon reboiler which has been in operation for almost 3 years. The solution flowing from the still to the reboiler in this installation contains rather appreciable amounts of acid gas, approximately 2 volumes per volume of solution, which in most cases would cause quite severe corrosion.

Corrosion of reboilers in aqueous amine plants is, as mentioned before, much more severe than in glycol-amine systems. The rate of corrosion depends mainly on the reboiler temperature and the skin temperature of the tubes. This is particularly true in cases where a heating medium, such as oil of high temperature, is used instead of the conventional steam. Difficulties encountered in the reboiler of

Figure 10. Downcomer, Third Tray below Feed Carbon Steel Still.

one installation were reported in a previous publication of the authors[4], and it has been found since that Monel appears to be a satisfactory material for the manufacture of reboiler bundles in such systems. This plant is operating at conditions which are especially conducive to corrosion, involving reboiler temperatures in the order of 280° to 290° F. and the use of a heating oil in the tubes with temperatures in the order of 450° to 550° F. The operators of this plant installed several steel and other alloys in the reboiler service and carried all test tubes to failure. The best materials were Monel and Carpenter 20 which failed after a total service of 451 days, and it was concluded on final inspection that the Monel was the most suitable material for this service. Recent communication from the operators of this plant[5] states that because of the very serious corrosion incurred with the hot oil system, the plant is being converted to the use of steam for reboiler heat and it is expected that the corrosion difficulties will be considerably alleviated by this move.

In another installation using a 30 percent monoethanolamine solution in water, severe corrosion of carbon steel reboilers was also encountered. This plant operated at reboiler temperatures of approximately 275° F. and used steam as a heating medium. In this installation, the total life of a carbon steel reboiler was approximately 9 months, but tube failures had occurred after approximately 90 days of operation. In order to alleviate the corrosion difficulty, the reboiler temperature was reduced to approximately 250° to 260° F., but no satisfactory performance of carbon steel equipment could be obtained by this means. In order to determine the suitability of other materials in this service, a small experimental reboiler bundle was constructed containing Monel, Type 304 and 316 stainless steel, aluminum and carbon steel tubes. This bundle was operated on a slip stream of the plant and after 70 days of operation, it was found that the carbon steel and Type 304 stainless steel tubes were severely pitted while the aluminum was in even worse condition. The Type 316 stainless steel tubes were pitted considerably but did not show as bad attack as the Type 304 stainless steel. Monel showed only slight etching which substantiated the experience with this material in other locations. A subsequent inspection of this bundle after 150 days showed the same results.

In one aqueous amine plant using a 20 percent monoethanolamine solution and operating with a reboiler temperature of 240° F. and steam as the heating medium, reboiler failures were observed approximately every 12 months. Tests with Monel and Inconel test tubes inserted in a carbon steel bundle indicated the suitability of these materials, especially of Monel, and a Monel bundle has recently been installed in that plant.

In general, it can be concluded that reboiler corrosion is the most severe aspect of the corrosion observed in aqueous amine plants. The life of carbon steel bundles in such installations varies from 60 days to more than a year, depending on the operating conditions of the plant. Reboiler temperature and the presence of oxidation products in the solution appear to be the principal factors influencing the rate of corrosion. Type 304 stainless steel does not seem to be a satisfactory material in all instances, although good results have been obtained with this alloy in some cases. The materials most suitable for this service appear to be Monel and, possibly, Types 316 and Carpenter 20 stainless steel.

Still Corrosion

Corrosion of regenerating stills has been observed recently in certain glycol and aqueous amine installations. These vessels are customarily manufactured from carbon steel and the discussion below will be concerned with carbon steel stills unless otherwise specified. Since it is the opinion of the authors that this problem is due to a considerable extent to the operating conditions of the plants, a short discussion of these conditions will precede the report on the actual corrosion observed. This discussion will be confined to stills operating in glycol-amine systems.

The rich solution leaving the contactor of the glycol-amine plant contains a certain amount of dissolved hydrocarbon gas, most of which is released upon reduction of pressure before entry of the solution into the heat exchangers. As the solution is heated in the heat exchangers, some of the acid gas is stripped and a mixture of rich solution, hydrocarbon gas and acid gas flows from the heat exchangers to the still. The hydrocarbon gas and some acid gas are flashed off in the still at the entry point of the solution and escape into the upper part of this vessel. In examining Figure 1, it can be seen that the rich solution is not fed into the top of the still, but somewhere in the middle, leaving several trays above the feed connection for reflux. The temperature of the rich solution entering the regenerating still varies over a considerable range in different glycol-amine installations, this range being in general between 200° and 260° F. It has been observed that at higher still feed temperatures and in the presence of relatively large amounts of hydrocarbon gas in the rich solution, appreciable corrosion occurred in the line leading from the heat exchangers to the still. Some of these lines which, in general, are made of carbon steel, corroded at an excessive rate and had to be replaced after one or two years of operation. In other installations where lower still feed temperatures were prevailing, the rate of corrosion, as could be expected, was appreciably lower. In order to alleviate the corrosion due to the presence of hydrocarbon gas in the solution, flash chambers have been installed in several plants, these chambers being located either between the contactor and the heat exchangers, before the hottest pass of the heat exchangers or after the heat exchangers. In one instance, flash chambers were installed at several of these locations. Although there has not been enough time to obtain conclusive results from these features in operation, it is felt that the removal of hydrocarbon gas has had some beneficial effect. The common practice at present is to keep the still feed temperature as low as possible, in general, between 220° and 240° F., and it is indicated that corrosion in the stills can be reduced substantially by this expedient.

Among a considerable number of glycol-amine treating plants varying in age from one to six years, in only three instances has excessive still corrosion been observed. This corrosion was confined to the solution transfer line from the exchangers to the still

Figure 11. Aluminum Trayway Cover Assembly, Lower Section of Still.

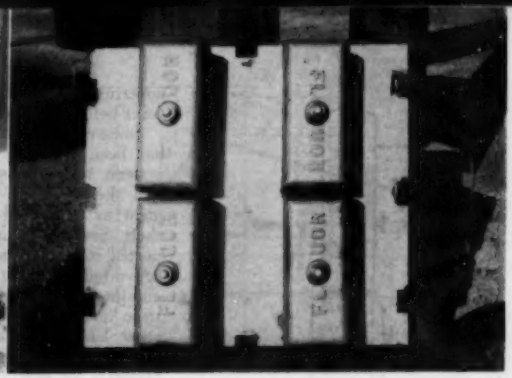


Figure 12. Aluminum Trayway Cover Assembly, First Tray above Feed.

and to an area defined by the feed tray on one side and the fourth tray below the feed on the other. No corrosion whatsoever was found in the stripping section above the feed inlet and only very minor corrosion could be detected in the bottom portion of the still. One glycol-amine plant regenerating still developed a hole in the shell in the vicinity of the solution feed and showed major corrosion on the trays immediately below the feed after 32 months of operation. The hole in the shell was repaired and the still was operated for an additional three months until repair was again necessary. After a total operating time of 42 months, the still was in such bad condition that it was decided to replace it with a new unit. Inspection of the vessel showed that general corrosion had occurred in the area indicated above, that the trays were thinned and that bubble caps, bolts and other appurtenances had suffered quite severely from corrosive attack. A new unit was installed and after six months was examined for corrosion. Bubble caps and hold-down bolts from Trays No. 10, 11, (feed tray), 12, 13 and 14 were removed and the bolts are shown in Figure 8. This plant had a rather bad corrosion history. It was operated for a considerable length of time with particularly high reboiler temperatures on the order of 325° F. and a still feed temperature of 200° to 240° F. Furthermore, it was suspected that oxygen entered the system through the suction of solution pumps. This plant also had high pressure drop heat exchangers which, in general, are not used in glycol-amine systems and which showed rather severe corrosion until Type 304 stainless steel tubes were used.

The regenerating still of another glycol-amine plant corroded to the extent that repairs were necessary after a period of operation of 14 months. This plant operated with a still feed temperature of 200° to 220° F. and a reboiler temperature of 300° F. A band of ¼ inch steel plate was welded around the shell in the general vicinity of the area indicated above and the vessel was placed back in operation. For the following 12 months, no repairs were necessary on this vessel although inspection of the internals of the still indicated that corrosion of the trays, downcomers and other parts had progressed. Preliminary experiments by the use of aluminum metallized carbon steel coupons installed on the feed tray of this still indicated some possibility of the use of aluminum metallizing for the repair or protection of still columns.

In order to investigate the suitability of aluminum for use in the solution transfer line from the exchangers to the still, an aluminum ell was installed in this line. Inspection after 12 months of operation showed no detectable corrosion.

Since it was indicated that aluminum is a suitable material for use in glycol-amine stills and since repair of the above described still had become necessary, it was decided to construct a section consisting of a carbon steel shell and an aluminum liner, trays, bubble caps and other appurtenances and to insert that section into the still. The liner, trays, bubble caps and risers were made from aluminum 3S and the other accessories from aluminum 61-ST. This section contains 6 trays and is welded into the still between the third tray above the feed and the fifth tray below the feed tray. Figure 9 shows a view of this still section without the bubble caps. This section was installed in the still during the week of April 16, 1951, at which time the corroded carbon steel section was available on the ground for detailed inspection. It was observed that the shell was badly corroded, particularly in the downcomer areas, and that the four trays below the feed point, together with their respective downcomers, were corroded to complete destruction in some areas. Figure 10 indicates a portion of the third tray below the feed point and its lace-like appearance demonstrates the severity of the attack.

In order to test the performance of aluminum in a glycol-amine plant regenerating still operating under somewhat different conditions; i.e., with high water content, a reboiler temperature of approximately 260° F. and a still inlet temperature of 160° to 210° F., trayway cover assemblies were constructed of aluminum alloys and inserted in the 20 trays of the glycol-amine plant still. These assemblies consisted of the following:

Trayway Covers—Aluminum 2S
Four Bubble Caps with Risers—
Aluminum Alloy 356
Hold-down Washers—Aluminum 2S
Hold-down Bars—Aluminum 61-ST
Nuts and Bolts—Aluminum 24-S and
304 Stainless Steel
Studs and Nuts—Black Iron

The assemblies were inspected for the first time after 30 days of operation and it was found that no corrosion had occurred in the units above the solution feed point of the still. Some corrosion was found on the other assemblies and it appeared that the corrosion had started at the feed tray and progressed downward, the worst area being on Trays No. 13 and 16, which are 8 to 11 trays below the feed point. Below that point, the corrosion decreased considerably and only minor attack was evident in the bottom part of the still. The bubble caps, vapor necks, hold-down bars, bolts and nuts in all assemblies did not seem to have suffered any corrosive attack. This plant, as mentioned before, was operated with a relatively high water content, approximately 40 percent, and is considered to constitute a borderline case for the applicability of aluminum in this service. As discussed in a previous publication,[3] the rate of corrosion of aluminum in amine solution increases with increasing amounts of water present and a composition of approximately 20 percent monoethanolamine, 40 percent diethylene glycol and 40 percent water is considered to be the permissible limit. A further in-

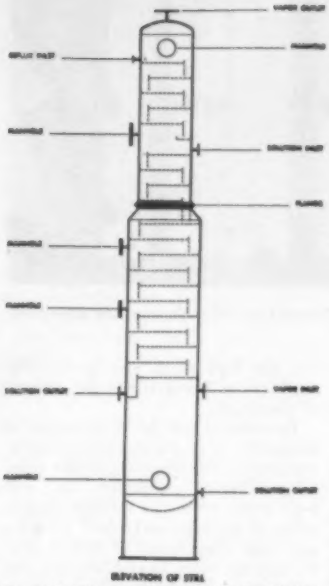


Figure 13. Schematic View, Combination Carbon Steel and Aluminum Still.

spection of the trayway assemblies after a total service of 208 days showed that the corrosion observed previously had progressed appreciably. This was particularly true with assemblies located in the lower half and at the bottom of the still column, as shown in Figure 11. Again, no corrosion could be found on the trays above the feed point nor on the bubble caps and other appurtenances in any location in the column. An assembly from a tray above the feed point is shown in Figure 12. Inspection of the carbon steel parts of the vessel indicated only minor corrosion and it was concluded after the second inspection that in a glycol-amine system containing 40 percent of water or more, carbon steel is probably a more suitable material for use in still construction than aluminum.

As a result of the experiments with aluminum in stills, a rather interesting design was developed for a still to be installed in a plant operating with a typical glycol-amine solution of low water content. This unit is shown schematically in Figure 13 and consists of two sections of different diameter joined by Van Stone flanges. The bottom section is manufactured from carbon steel while the top section is fabricated entirely from aluminum. The top section, which contains a total of nine trays, includes the solution inlet and four trays below that point. It is felt that such an installation should perform equally satisfactorily or better than an aluminum lined steel section covering the critical region of four trays below the solution entry.

Some corrosion of carbon steel stills has been reported in aqueous amine systems which, in some instances, has had the aspect of caustic embrittlement as evidenced by cracks in the shell. Several instances have been reported in which such stills have been converted from tray to packed columns and the internal surfaces of the column were "gunited" before packing. On the other hand, some aqueous amine regenerating stills have performed satisfactorily for several years although in some cases units have been constructed initially with stainless steel linings. Experience in aqueous amine systems indicates that stress relieving of still columns is beneficial in reducing the rate of the corrosion.

In general, it can be concluded from the evidence gathered at this writing that carbon steel may be a satisfactory material for use in glycol-amine treating plants provided certain operating practices are observed. It is felt, however, that the most vulnerable part of these stills, which is a section including approximately four trays below the solution feed point, can be protected against excessive corrosion by the use of alloy liners such as the aluminum liner described above, or construction of the upper part of the column entirely of aluminum.

Corrosion in a Special Application of the Amine Process

Some time ago, two plants were constructed in which hydrogen sulfide is being absorbed from a gas stream leaving the still of an aqueous amine plant treating a refinery gas. This stream contains a very large amount of hydrogen sulfide which is absorbed in a solution containing 75 percent monoethanolamine and 25 percent of water, and the solution is being saturated to a very high degree. The purpose of this operation is to absorb a large volume of hydrogen sulfide in a small volume of solution and to transport this solution to a different location where it is stripped of its hydrogen sulfide which is converted subsequently to elemental sulfur. In order to dissipate the considerable heat of reaction generated in the process of absorbing hydrogen sulfide in the amine solution, the absorber consists of a vertical shell and tube carbon steel heat exchanger which is operated in such a manner that the solution and the gas flow concurrently in one pass through the shell and water flows through the tubes. In one of these plants, quite severe corrosion of both the carbon steel tubes and shell was observed after an operating period of approximately 90 days. The tubes failed near the inlet side of the solution where the highest temperature occurs, in the order of approximately 200° F. These tubes and shell were subsequently replaced with Type 304 stainless steel and satisfactory performance was obtained. In the other plant, a certain amount of saturated solution was recycled and a reduction of temperatures thus obtained. The maximum temperature in the reactor exchanger was in the order of 110° F. During an operating period of nine months, two inspections of the bundle operating in the latter plant were conducted and practically no corrosion of the carbon steel tubes was found. The carbon steel tube sheets and baffles were also free from corrosion.

In order to test different alloys in this service, test specimens of the following materials were inserted in the reactor exchanger near the solution inlet and tested for a period of seven months:

Aluminum 2S
Aluminum 3S
5% Nickel Steel
9% Nickel Steel
Type 304 Stainless Steel
Type 316 Stainless Steel
2¼ Cr.-1 Mo. Steel
4-6 Cr.-½ Mo. Steel

The only two materials which showed appreciable corrosion were the 5 percent nickel steel and the 2¼ Cr.-1 Mo. steel. Both of these materials showed more corrosion than a control specimen of carbon steel. Although it is agreed that carbon steel is a perfectly satisfactory material in this service under the proper operating conditions, it should be pointed out that aluminum 2S and 3S, Types 304 and 316 stainless steel and 4-6 Cr.-½ Mo. steel are equally satisfactory in this application.

Corrosion of Carbon Steel And Alloys in an Aqueous Methyldiethanolamine Solution

Since laboratory and pilot plant studies have indicated that methyldiethanolamine is a suitable agent for selective absorption of hydrogen sulfide in the presence of carbon dioxide and commercial application of this process is being developed,[6] a laboratory study has been conducted in order to determine the corrosiveness of this amine towards carbon steel and different alloys. The experimental work was conducted in the pilot scale apparatus simulating different parts of a treating plant, previously reported.[3] The following materials were tested:

Carbon Steel
4-6 Cr.-½ Mo. Steel
Aluminum 3S
Type 304 Stainless Steel
Arsenical Admiralty Metal
Phosphorized Admiralty Metal

The equipment was operated in such

a manner that specimens were exposed to a 50 percent aqueous methyldiethanolamine solution at 5 different conditions; i.e., an acid gas saturated solution at approximately 90° F., an acid gas saturated solution at approximately 185° F., a partly stripped solution at approximately 90° F., a partly stripped solution at 220° F. and a stripped solution at 90° F. The ratio of CO_2:H_2S in the solution was approximately 1:1. The results from this investigation indicate that carbon steel corroded to a minor extent in the acid gas saturated solution at 185° F. but did not show any corrosion in the saturated, partly stripped and stripped solutions at 90° F. and 220° F. 4-6 Cr.-½ Mo. steel, Type 304 stainless steel and aluminum 3S did not corrode at any of the conditions tested. Arsenical and Phosphorized Admiralty metal corroded quite severely in saturated and partly stripped solutions at 90° F. and 185° F. but did not corrode in stripped solutions at 220° F. and 90° F. A comparison of the corrosion of carbon steel in a 50 percent aqueous methyldiethanolamine solution and a typical glycol-amine solution containing 15 percent monoethanolamine, 80 percent diethylene glycol and 5 percent water indicates that under the test conditions, less corrosion had occurred in the methyldiethanolamine system. A graph showing the difference in corrosion rate in the two solutions is presented in Figure 14.

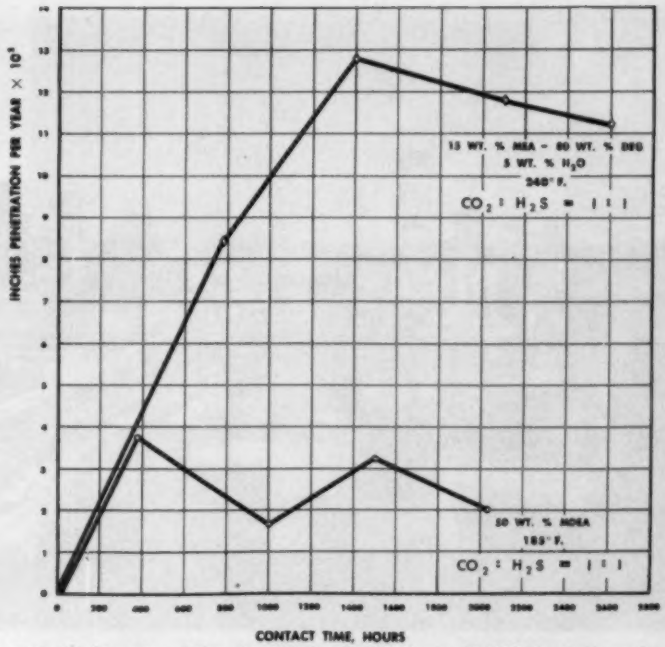


Figure 14. Comparison of Corrosion of Carbon Steel in Aqueous-Methyldiethanolamine and Conventional Glycol-Monoethanolamine Solutions.

Conclusions

On the basis of the results obtained from the corrosion study which has been conducted over the past three years, the following conclusions can be drawn at this date:

Glycol-Amine Systems

Heat exchanger corrosion, which constitutes the major corrosion problem in glycol-amine plants, can be controlled satisfactorily by use of aluminum 3S or 4-6 Cr.-½ Mo. steel in the manufacture of exchanger bundles.

The data available at present indicate that carbon steel reboiler bundles can be used economically provided that the proper operating conditions are maintained in the plant. A life of 3½ to 4 years can be expected from such bundles under such conditions.

Although most carbon steel stills have given satisfactory service at this writing, the incidence of some failures in parts of these columns indicates that carbon steel is not an entirely satisfactory material for such service. Other materials have been and are still being investigated and at present, it is felt that a satisfactory remedy for still corrosion can be provided by the use of aluminum or stainless steel lining in the region of the still defined by the feed tray and the fourth tray below the feed, or by constructing the entire upper portion of the still of such alloys. At present, aluminum is to be preferred for economic reasons as well as its indication of satisfactory corrosion resistance. In addition, preliminary small scale experiments have indicated the possibility of utilizing aluminum metallizing for repair and protection of this region of still columns.

Aqueous Amine Systems

In most aqueous amine installations, carbon steel is a satisfactory material for the manufacture of heat exchanger tubes. However, in certain plants where particularly corrosive conditions prevail, carbon steel and 304 stainless steel did not give satisfactory performance. Although little experimental evidence is at hand, it is felt that Monel, Carpenter 20 and possibly 316 stainless steel should perform satisfactorily in such cases.

Reboiler corrosion, which in most aqueous amine plants constitutes the major corrosion problem, can be controlled satisfactorily by use of Monel, Carpenter 20 and Type 316 stainless steel for the fabrication of reboiler bundles. Monel has so far shown the best results. In any case, however, the use of high temperature heat medium oil and direct firing, which involves excessively high metal skin temperatures, are definitely contraindicated.

Experience indicates that in most instances, carbon steel has performed reasonably satisfactorily in aqueous amine stills. At present, no information is available on the use of alloys in such installations except Type 304 stainless steel, which has given adequate service in a few stills operated for considerable periods of time.

ACKNOWLEDGMENT

The authors wish to express their appreciation to the engineering and operating staffs of El Paso Natural Gas Company, The Griscom-Russell Company, the Aluminum Company of America, The International Nickel Company, Inc., and to the staff of the Research and Development Department of The Fluor Corporation, Ltd., for their valuable assistance in providing materials and information used in this presentation. The cooperation of Carbide and Carbon Chemicals Corporation is also gratefully acknowledged. Finally, the authors wish to thank the management of The Fluor Corporation, Ltd., for their permission to prepare and present this article.

BIBLIOGRAPHY

[1] Purification and Dehydration of Gases, C. L. Biohm and W. F. Chapin, California Oil World, Vol. 41, p. 13 (June, 1948).

[2] Technical Aspects of Glycol-Amine Gas Treating, A. L. Kohl and C. L. Biohm, The Petroleum Engineer, Vol. 22, No. 6, p. C37 (June, 1950).

[3] Corrosion Problems in Gas Purification Units Employing MEA Solutions, F. C. Riesenfeld and C. L. Biohm, Petroleum Refiner, Vol. 29, No. 4, p. 142 (April, 1950).

[4] Corrosion in Amine Gas Treating Plants, F. C. Riesenfeld and C. L. Biohm, Petroleum Refiner, Vol. 30, No. 2, p. 97 (February, 1951).

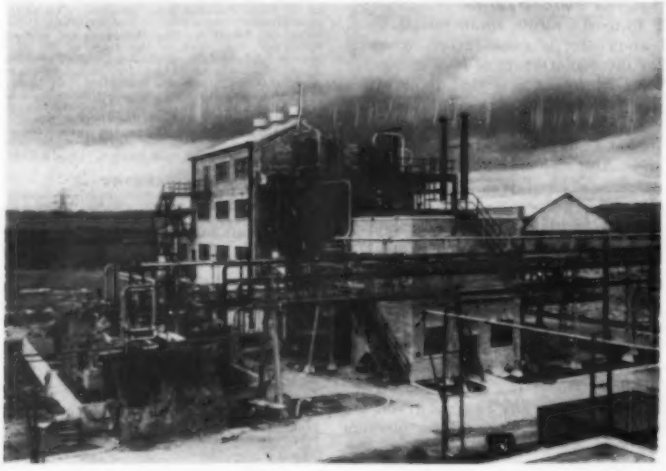
[5] Corrosion in CO_2-H_2S-Amine Systems, K. L. Hujsak, G. R. Davis and E. C. Carlson, Kansas City Meeting, American Institute of Chemical Engineers (May, 1951).

[6] Selective Absorption of Hydrogen Sulfide from Gas Streams, H. D. Frazier and A. L. Kohl, Industrial and Engineering Chemistry, Vol. 42, p. 2288 (November, 1950).

Monsanto's New Petrochemical Manufacturing Units at Newport, England

Monsanto Completes Newport Petrochemical Installation

Exterior View of Aroclors Plant



MONSANTO Chemicals Ltd., engaged in a continuous expansion program since 1928 when it acquired full interest in the British Ruabon Works located at Newport, England, recently marked completion of stage one of a revitalized expansion initiated in 1946. Completion of the $8.4 million factory at Newport meant that Britain could manufacture many important chemicals and chemical byproducts which she had formerly had to import. In all, Monsanto has invested about $14.7 million in new plant units during the period 1947-1950.

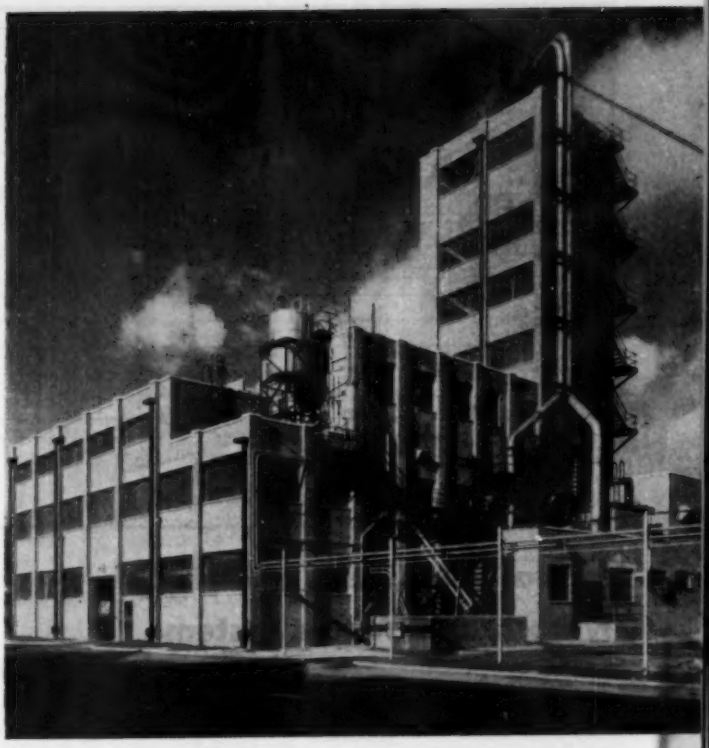
The present layout at Newport represents only one stage of the full program and is designed for the production of styrene plastic, detergents, oil additives, preservatives, fungicides and Aroclors (chlorinated diphenyls). Petroleum fractions form the starting point in synthesis, but other chemicals—chlorine, sulfuric acid and caustic soda, are also used in large amounts.

Santomerse Plant

The Santomerse plant, including the tank farm, production section and warehouse, is the largest in the factory, with an over-all length of 1000 feet and width of 150 feet. Raw materials are fed into the processing plant from a system of vats, hoppers and pipe lines reaching above the main roof level. In the first stage of manufacture, a synthetic hydrocarbon is prepared. This compound has a normal chain structure except that, by

chlorination, it has been given a "soft spot." The chlorinated hydrocarbon is made to react in the presence of a catalyst with benzene, thus completing the organic portion of the molecule. Control within fine limits is required and all byproducts and unreacted material are removed by careful distillation and washing. When the organic portion of the molecule has been built up the polar group is introduced into it. This entails treatment with sulfuric acid, any excess of which is carefully removed, and then with caustic soda. It now only remains to compound and dry the finished product. A number of corrosion resistant vessels, some solid nickel and others lined with silver or enamel, are used in these operations. Glass linings offer sufficient resistance in some of the reactions, but others require special containers of Monel metal. Certain of the storage tanks are rubber-lined.

The series of reactions which produce the detergent are fully instrumented, and the control room has numerous meters along all the four walls. Above the central panel is the "enunciator board" listing each stage of the process by name. Should any breakdown occur in the plant an appropriate panel indicates the site of the trouble. Colored lights display the stage which each operation has reached, and there are safety controls which operate automatically in any emergency.



The 120-Foot Tower of the Lustrex plant dominates the entire installation at Newport.

Polystyrene Production

The 120-foot tower of the Lustrex plant dominates the entire Newport factory. The whole building is designed to house the equipment for polystyrene production, in which water-clear liquid monomeric styrene is converted into crystal clear, or variously colored, polystyrene pellets. The building air supply is conditioned and dust removed to ensure high purity of the finished product. Lustrex, a light, transparent thermoplastic, will for the first time be made in commercial quantities in this British factory.

The oil additives plant is housed in a three-story structure 150 feet long and 60 feet wide. The raw materials are distributed by lift from ground level, and each floor is of open grill-work to aid ventilation. The ground floor is tiled and drained to facilitate cleaning. Overhead cranes enable quick handling of heavy equipment. The plant is designed as a multi-purpose flexible unit so as to break down various manufacturing processes to a series of fundamental reactions—chlorination, sulfonation, etc. Stations are designed for each of these reactions such that they can be linked in any required order and their working conditions varied at will. Thus the same plant can produce many different additives, including a detergent which keeps engines clean an eliminates ring-sticking, a complex sulfur-containing organic compound with a marked capacity for arresting breakdown of lube oils by oxidation during actual engine use, and an additive which keeps oil fluid at low temperatures.

Manufacture of Aroclors

Benzene forms the starting point for the manufacture of Aroclors. It is first converted to diphenyl by thermal condensation followed by the addition of chlorine groups. Accurate temperature control is maintained to prevent accumulation of impurities. After chlorination the product is fractionally distilled to yield different grades of Aroclors, varying from mobile liquids to clear wax. Boiling points of waxes range up to 1270° C. The lowest solidification temperature of the liquids is 35° C. The most inflammable product has a flash point as high as 140° C.

Production at Newport of the fungicides and wood preservatives completes the list of products turned out. These are pentachlorophenol preparations, and their manufacture is thus a chlorinating reaction.

Nearly 4000 instruments keep the various reaction conditions accurate within fine limits. Overhead pipe lines are color-coded and bring by such means liquid raw materials from storage farms. These arterial liquids, together with diesel oil, water and steam at high and low pressures travel in a system of parallel pipes. Chlorine for the various manufacturing processes is made in a modern electrolytic plant which also yields caustic soda.

Overhauling and testing of the many instruments controlling the chemical processes is carried out in a large workshop capable of doing most types of maintenance work and small scale construction, as well as fabrication of parts for use in the experimental plant. An efficient effluent plant ensures safe disposal of all waste liquors, which are neutralized if necessary, or given other appropriate treatment.

Two modern laboratories for research and development, staffed by experienced chemists and engineers, operate in close liaison with universities, research institutions and other bodie both at home and abroad. The company also has the great advantage of enjoying full exchange of technical information with its American parent firm.

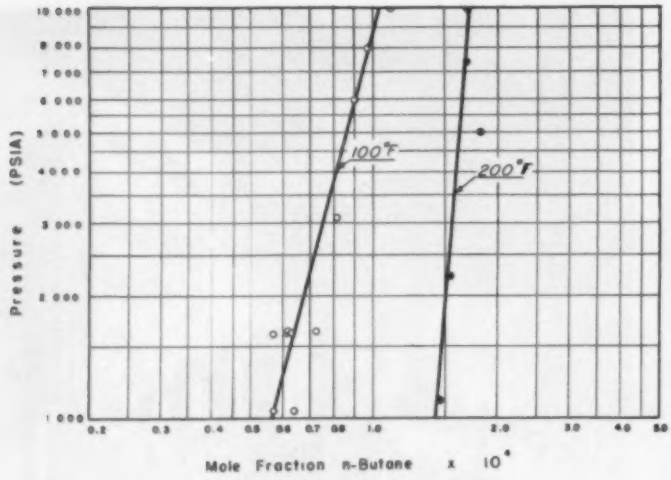


Figure 1. Solubility of n-Butane in Water.

EXPERIMENTAL compositions of the coexisting liquid phases of the n-butane—water system are presented at pressures from 1000 to 10,000 psia and at temperatures of 100° F. and 220° F.

These data are compared with data previously reported in the literature at the same pressure and temperature conditions for methane, ethane and propane.

Mr. Gibbs is now associate editor of PETROLEUM REFINER.

Mutual Solubilities of Light Hydrocarbon-Water Systems

W. B. BROOKS, G. B. GIBBS and J. J. McKETTA
Department of Chemical Engineering,
The University of Texas, Austin

FUNDAMENTAL data on the mutual solubilities of hydrocarbon—water systems are useful in studying the behavior of petroleum reservoirs and petroleum products in contact with water. Data on the light hydrocarbon—water systems are important in the design and operation of LPG process equipment. Of the light hydrocarbons the methane—water,[3,5,6,11] the ethane—water,[3,4,8,13] and the propane—water systems[2,7,12] have been reported previously. Solubility data on the *n*-butane—water system have been reported up to the three phase critical point.[1,14] Additional data on light hydrocarbon mixtures have also been presented.[9,10]

Presented here are the results of an investigation of the *n*-butane—water system at pressure from 1000 to 10,000 psia and temperature of 100° and 200°F. Under these conditions of pressure and temperature, compositions of the two coexisting liquid phases are reported.

A comparison is made of the light hydrocarbon—water systems. The compositions of both the water-rich and hydrocarbon-rich phases are shown.

The experimental technique and analytical procedure have been described in detail previously.[3] Essentially, the procedure consisted of agitating a butane—water mixture in a steel equilibrium cell for four hours at the desired pressure and temperature. Mercury was used as the confining fluid. After the attainment of equilibrium, samples of the phases were withdrawn into an analytical train which contained U-tubes filled with Dehydrite (magnesium perchlorate trihydrate). The weight of the water absorbed by the Dehydrite and the volume of the butane gas gave the basis for the calculations of the compositions.

TABLE 1
Experimental Values for the Mutual Solubility of *n*-Butane and Water

Pressure (psia)	Temperature (°F.)	Butane-Rich Phase (Mol Fraction H_2O)	Water-Rich Phase (Mol Fraction C_4H_{10})
1055	100	0.001053	0.0000642
1055	100	.....	0.0000570
1615	100	0.000716	3.00E3564
1620	100	0.000748	0.0000630
1630	100	0.000715	0.0000727
1645	100	0.001315	0.0000615
3025	100	0.000960	.....
3085	100	0.001225	0.0000810
4006	100	0.000507	.....
4865	100	0.001290	.....
5025	100	0.000985	.....
6015	100	.....	0.0000886
7005	100	0.000930	.....
7985	100	0.000980	0.0000857
9915	100	0.000973	0.0001099
1115	220	0.00770	0.0001462
2235	220	0.00552	.....
3025	220	0.00255	0.0001848
3425	220	0.00511	.....
5015	220	0.00705	0.0001817
6765	220	0.00433	.....
7415	220	0.00300	0.0001726
10065	220	0.00417	0.0001683

Materials

The *n*-butane used in the investigation was Phillips Petroleum Company's pure grade stock and is certified to have a minimum purity of 99.0 mole percent. The water was taken from the distilled water source of the laboratory, and was boiled to remove dissolved gases and then saturated with

TABLE 2
Smoothed Values for the Mutual Solubility of *n*-Butane and Water

Pressure (psia)	Temperature (°F.)	Butane-Rich Phase (Mol Fraction H_2O)	Water-Rich Phase (Mol Fraction C_4H_{10})
1000	100	0.0009	0.0000562
1500	100	0.0009	0.0000622
2000	100	0.0009	0.0000670
2500	100	0.0009	0.0000709
3000	100	0.0009	0.0000744
4000	100	0.0009	0.0000802
5000	100	0.0009	0.0000849
6000	100	0.0009	0.0000888
7000	100	0.0009	0.0000923
8000	100	0.0009	0.0000956
9000	100	0.0009	0.0000985
10000	100	0.0009	0.0001020
1000	220	0.00731	0.000145
1500	220	0.00655	0.000149
2000	220	0.00605	0.000152
2500	220	0.00569	0.000154
3000	220	0.00541	0.000157
4000	220	0.00500	0.000159
5000	220	0.00471	0.000162
6000	220	0.00448	0.000164
7000	220	0.00430	0.000166
8000	220	0.00414	0.000167
9000	220	0.00402	0.000168
10000	220	0.00390	0.000170

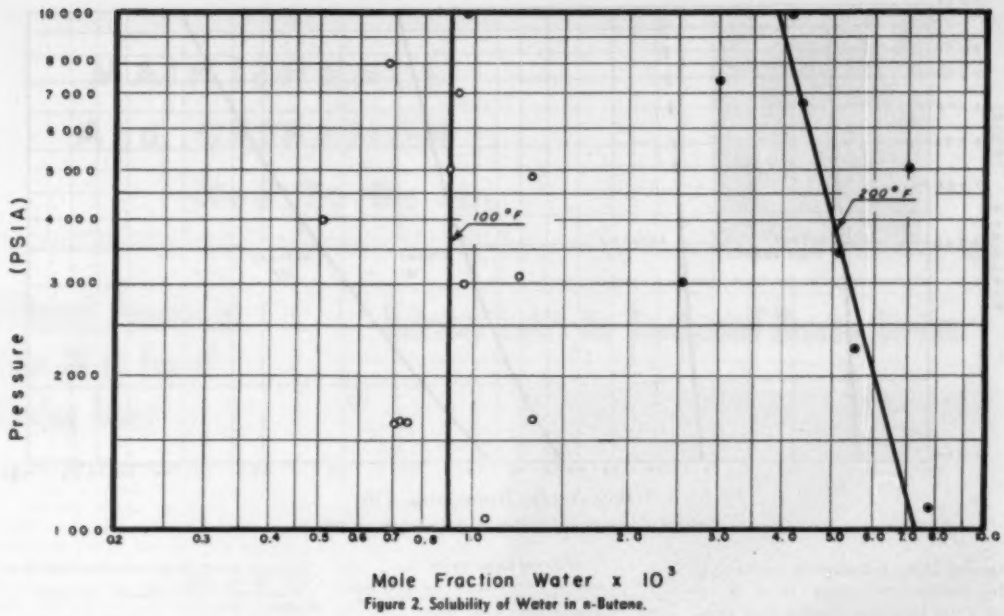


Figure 2. Solubility of Water in n-Butane.

n-butane before use.

Experimental Data

The experimentally determined composition of the hydrocarbon-rich liquid and the water-rich liquid phases in the *n*-butane — water system are shown in Table 1 and in Figures 1 and 2. The average deviation of the experimental values from the smoothed values for the water-rich phase at the 100° and 200°F. isotherms are 8.0 percent and 2.5 percent, respectively. The greater accuracy is obtained at the higher isotherm since the volume of the butane being measured was approximately three times as large.

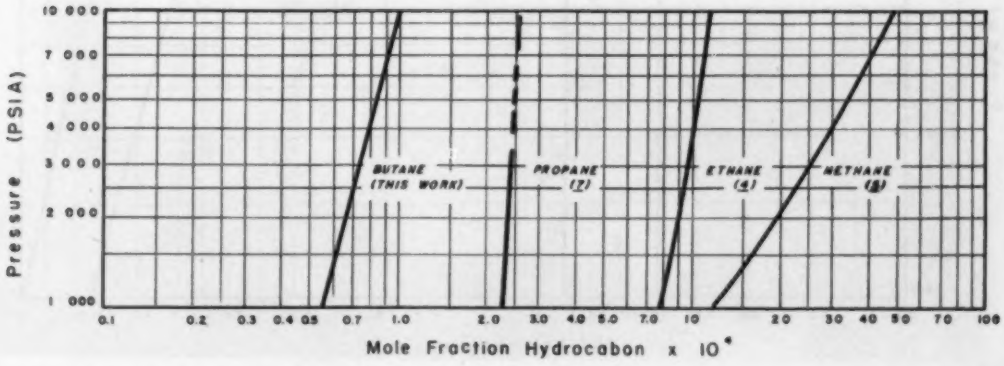
For the butane-rich phase, Figure 2, the average deviations of the experimental values from the smoothed data for the 100° and 200°F. isotherms are 25 percent and 18 percent, respectively. At first glance these deviations appear large; however, the weight of water being measured in a usual sample of 50 grams of the butane-rich liquid was only 0.010 grams.

Comparative Solubilities

The smoothed results of this investigation concerning the solubility of butane in the water-rich phase are shown in Figures 3 and 4 with similar smoothed results for methane,[5] ethane,[4] and propane.[7] It can be seen from these figures that the effect of pressure is similar for the solubilities of these four hydrocarbons in water. The solubility of the hydrocarbon decreases as the molecular weight increases. The data for propane have been extrapolated above the experimental pressures of 3000 psia.

The smoothed values of the water solubility in the butane-rich phase are compared with the smoothed values of the water solubility in the propane-rich phase[7] in Figure 5. Since these conditions of pressure and temperature are above the critical values of methane and ethane, these latter two hydrocarbons are not included in the comparison. At the 100°F. isotherm, the water solubility in the butane-rich liquid is greater than in the propane-rich liquid. This observation is commensurate with the trend found by Black, Joris and Taylor,[1] who reported that the water solubility increases in

Figure 3. Comparative Solubility of Hydrocarbons in Water at 100° F.



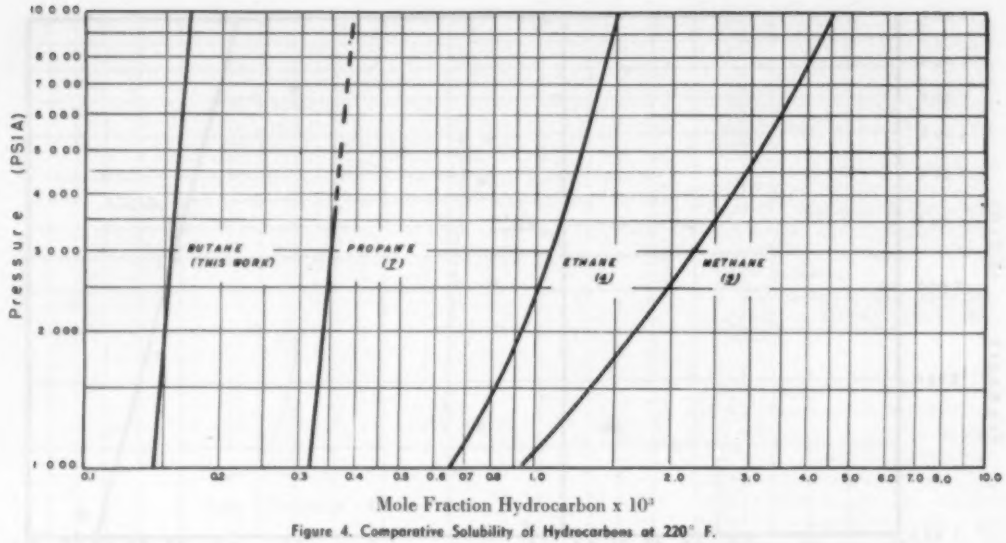


Figure 4. Comparative Solubility of Hydrocarbons at 220° F.

passing from *n*-butane to *n*-octane in the temperature range from 5° to 30° C. at pressures from 1 to 6 atmospheres. At the 220° F. isotherm, however, the water solubility in the butane-rich phase is slightly less than in the propane-rich phase. This reversal is possibly due to the fact that the propane is above its critical temperature at 220° F. and behaves more like a gas than a liquid.

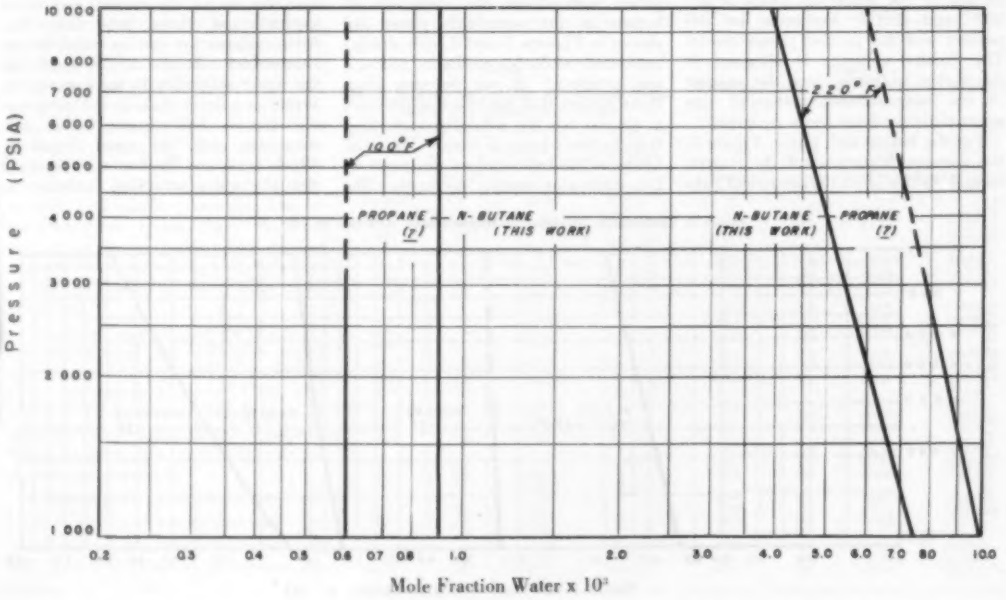
ACKNOWLEDGMENT

The writers are grateful for the assistance of the Phillips Petroleum Company, who supplied the *n*-butane used in this work.

LITERATURE CITED

[1] Black, Joris, and Taylor, J. Chem. Phys., **16**, 537 (1948).
[2] Chaddock, Ph. D. Dissertation, University of Michigan, 1940.
[3] Culberson, Horn, and McKetta, A.I.M.E. Petr. Div., **189**, 1 (1950).
[4] Culberson and McKetta, Trans. A.I.M.E. Petr. Div., **189**, 319 (1950).
[5] Culberson and McKetta, Trans. A.I.M.E. Petr. Div., **192**, 223 (1951).
[6] Frolich, Tauch, Hogan, and Peer, Ind. Eng. Chem., **23**, 543 (1931).
[7] Kobayashi, Ph.D. Thesis, University of Michigan, 1950.
[8] Kuenan and Robson, Phil. Mag., **48** (5), 180 (1899).
[9] McKetta and Katz, Trans. A.I.M.E. Petr. Div., **170**, 34 (1947).
[10] McKetta and Katz, Ind. Eng. Chem., **40**, 853 (1948).
[11] Olds, Sage, and Lacey, Ind. Eng. Chem., **34**, 1223 (1942).
[12] Poettmann and Dean, Petr. Ref., **25**, 635 (1946).
[13] Reamer, Olds, Sage, and Lacey, Ind. Eng. Chem., **35**, 790 (1943).
[14] Ibid., **36**, 381 (1944).

Figure 5. Comparative Solubility of Water in Hydrocarbons.



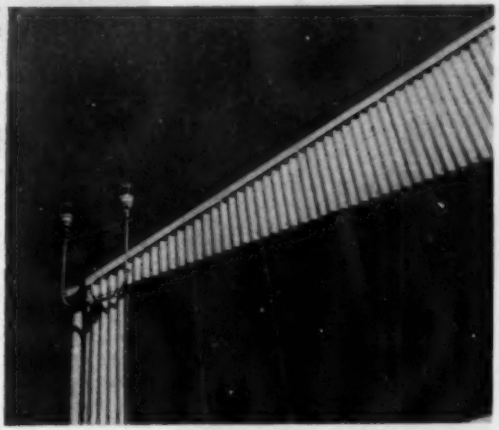
MAINTENANCE And OPERATION How To Do It—

Efficient Transfer of Lube Oil to Top of Cooling Tower

WHERE induced draft cooling towers are used, transferring lube oil to the top of the structure for lubricating the engine-driven fans becomes a periodic chore. Usually, this operation involves the use of a davit crane with block and tackle plus several men to hoist the barrel of oil from the ground to the top deck of the tower. Now, the job can be done by the plant operator without interferring with his normal duties.

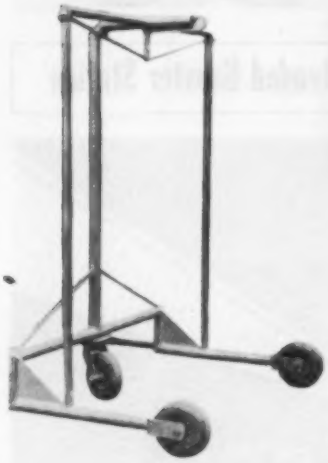
The drum rack for oil barrels is placed at the end of the engine room, where various grades of oil are stored for use in engines and crankcases. A small steam pump, 3 x 2 x 3, is set behind the drum rack. Instead of steam for power, compressed air is piped through a half-inch line to the pump. A set of fittings on a full swing connection has been assembled with a nipple to screw into the barrel bung hole. To avoid spilling the contents of the barrel, the barrel connection is made by first removing the nipple at the union and rolling the barrel to a position where the bung hole is at the top. After the nipple is screwed into the bung hole, the barrel is rolled back into position with the nipple at the bottom, where the connection to the pump suction is secured. The oil is discharged through a ¾-inch line to the top of the cooling tower, where a supply barrel is filled without the use of manpower. The operator needs only to make the necessary

Indicator Lights for Unattended Booster Station



WHEN a booster station is built to operate unattended, signal devices can be used to notify an operator at a distant plant whether the unit is operating or is automatically shut down. The unit illustrated has been provided with two lights, one red and one green, on the roof of the unattended building. The unit is equipped with the necessary safety devices for shut down in case of an excessive oil flow rate, a sudden drop in oil supply or an excessive jacket-water temperature. The instruments operating the lights are conventional switches which hold the green lamp circuit closed while the unit is operating according to plan and open this circuit while closing the red lamp circuit when the unit is shut down. The plant is visible from an attended plant, where the operator frequently looks toward the signal lights to determine the status of the unit.

connections and start the pump. When he notices that the transfer pump has lost suction, he can shut off the power and make the disconnections at his leisure.



Straddle Hoist Frame Helps in Maintenance

IN A PLANT where the rail-type trolley was not installed, a simple straddle hoist frame was devised to remove cylinder heads. Three vertical posts of standard pipe were welded to a horizontal frame. The two horizontal members were spaced parallel at a sufficient distance to straddle the cylinder and connecting piping. Pneumatic tires were incorporated on the two horizontal members and a third, as a caster, was installed beneath one of the vertical posts. Gusset plates and braces welded into the unit provide adequate strength to support any cylinder head that may be removed from a power or compressor cylinder. Cross members at the top of the vertical posts are designed with a loop into which the hook of a chain hoist may be inserted. Ball bearing axles and pneumatic tires make it possible for one man to lift the head and wheel it away from the engine so that the piston may be subsequently removed. The hoist may also serve to remove a heavy piston after the head has been removed.

Safety Shield is Provided at Flywheel

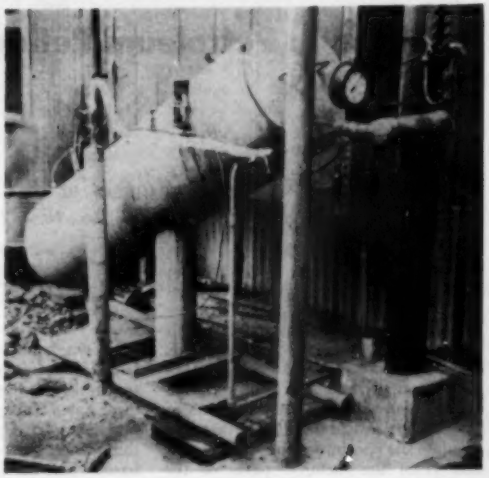
A SAFETY shield to warn personnel not to work on an engine in operation and to protect them from accidentally falling on the revolving flywheel is attached to all twin horizontal compressors. The shield itself is made from a square sheet of metal, similar in weight to average tread stock, and is welded to a frame fashioned from one-inch pipe. Substantial hooks, made of half-inch bar, are welded to the top of the vertical members to hang on a support reaching from one side of the engine to the other. The support is a joint of 1½-inch pipe flattened at each end and drilled to match holes in the cylinder distance piece, where cap screws hold the bar in place. The shield need not be removed from the engine when jacking over for the starting spot, as it will slide on the bar toward either compressor cylinder. The warning notice is stencilled as shown in the illustration.

Battery Carrying-Charging Operation Combined

FREQUENT charging of individual batteries is eliminated by combining the battery charger with the cart carrying the batteries. Before this combination was utilized, the batteries for starting individual engines were transferred to the plant shop for recharging, where they were out of service for 12 to 24 hours depending upon how depleted the charge had become. The cart is a simple wagon with small wheels adequate for trundling over a concrete floor. The standards supporting the table on which the batteries rest are of sufficient height to permit the insertion of a conventional charger between the legs. After each application of power to start an engine, the batteries are recharged to their maximum capacity, as indicated by an hydrometer. With this arrangement the batteries always remain within a convenient distance of any engine where they may be required.

Picture of Handy Carrying-Charging Car for Batteries.

Steam-Heated Case Provided for Ammonia



WHERE ammonia is used for neutralization in a distillation column, a steam heated case has been successfully used to maintain a predetermined temperature for constant ammonia flow. The cylinder case is a joint of pipe with an inside diameter large enough to permit slipping the cylinder in and out. Thoroughly jacketed with insulation, the case is installed at an angle of 45 degrees. The case is supported on a single pedestal of six-inch pipe welded into a base. Steam flows through a jacketed copper tube to a thermostat which admits the necessary amount of steam for constant temperature control. Two take-offs are provided; the one through the thermostat discharges hot condensate and steam to the cylinder case, while the other traces the transfer line to the point of injection. The upper end of the case is provided with a circular cover, which is slotted and locked into position with self-aligning lugs. To maintain a constant condensate level in the case, excess water is bled through an overflow line at the upper end.

Simple Utility Cart Serves Many Needs

A UTILITY cart has been built by a dexterous mechanic to transport small tools and other loads around an engine room. The three wheels are provided with pneumatic tires to permit easy riding. The floor of the cart is a rectangular sheet of tank steel bound around the edges with two-inch angle iron, securely welded at regular intervals. Wheel fittings at the rear are welded to the outside edges of the cart floor, but the journals may be disassembled for packing or repair. The single front wheel is a caster type with a tongue free to move up or down. Built intentionally as a low-bed unit, the distance from the floor to the bed of the cart is such that only superficial lifting is required for loading and unloading. The dimensions of the cart bed are such that two batteries will nest snugly within the angle iron rails.

Employes Safeguarded From Chemical Burns By Emergency Shower

AN EASILY made emergency shower provides means of minimizing acid burns in a water treating building at a gas compressor station.

The shower was constructed by installing ¾-inch pipe to the doorway of the water treating building where acids and other harmful chemicals are handled every day by operating personnel. To the end of the pipe a quick opening ¾-inch plug was screwed. On the end of the valve, an ordinary shower nozzle was installed. A handle for the shower was made from a length of 3/16-inch acetylene welding rod as shown.

When an operator suffers acid burns, he can quickly flood himself by pulling the handle of the quick-opening valve.

Analyses of Some Corrosion Problems in Petroleum Refineries

JOHN F. MASON, JR.
The International Nickel Co., New York

PRESENTED IN this article are 15 case records of actual corrosion problems. The problems concern the initial use of carbon steel for the various equipment items and their premature failure for one reason or another. Among the services involved are gas oil, depropanized naphtha, crude oil, spent sulfuric acid alkylate, naphthenic base crudes, caustic soda and sodium plumbite, furfural, reduced crude vapors and cracked propane distillate. The refinery units consisted of heat exchangers, regenerator towers, crude flash towers, accumulators, cracking coils, light fuel oil treaters, process furnace tubes, and debutanizer tower tops.

Original presentation was before the Petroleum Mechanical Engineering Conference, of The American Society of Mechanical Engineers, in Tulsa, September 24-26, 1951.

CORROSION of equipment in petroleum refineries has for many years represented a major portion of operating costs and oftentimes this condition has been aggravated by the misapplication of available metals and alloys. Over the past 25 years the Corrosion Engineering Section of The International Nickel Company has been active in investigating corrosion problems in the petroleum industry and considerable quantitative information has been obtained on the behavior of different materials of construction under varying conditions of service. Presented here is an analysis of 15 actual problems concerning corrosion of refinery equipment submitted for our consideration. The solutions to the problems are based on the accumulated practical experience of the staff of the Corrosion Engineering Section as well as on such quantitative test data as we have developed in refinery services through the use of our spool-type specimen holders.

An illustration of the spool holders referred to is shown in Figure 1. Briefly, the assembly consisted of previously cleaned and weighed specimens of the several metals and alloys to be tested, mounted on the spool-type holder with non-metallic parts of Bakelite or porcelain to separate and insulate the specimens from each other and from the metallic parts of the holder. Two similar specimens of each material were included on each spool. The completed test assemblies were fastened firmly in place in the desired test locations in operating plant equipment and allowed to remain for sufficient lengths of time to give reliable indications of corrosion behavior. Each of the test specimens used had an exposed area of 0.5 square decimeter.

Upon completion of tests, the spools were removed, dismantled and the specimens examined, cleaned of all scale and corrosion product, and reweighed. From the weight losses, areas of specimens and duration of exposure, the corrosion rates were calculated in terms of milligrams per square decimeter per day (mdd), and these rates transposed to inch penetration per year (ipy), the unit used in the accompanying tables. This unit is based upon the assumption of uniform corrosion in practice from one side of the metal only. The rate shown for each material is the average of the two specimens included in each test. In addition, each specimen was examined for cracking, pitting, and other forms of local attack. Where pitting or local attack occurred, depth of the five or ten deepest pits was measured microscopically or with a depth gauge. This method of test was substantially in accord with ASTM Recommended Practice for Conducting Plant Corrosion Tests, A224-41. (ASTM Standards, Part I, p. 522, 1944).

The problems submitted for analysis follow:

Problem 1

Materials Used: Steel tubes with an 0.095-inch wall in a heat exchanger used in combined straight run and cracking distillation service gave a life of only 9 months when failure occurred due to pitting and general corrosion, particularly where the tubes passed thru the steel baffle plates. Muntz metal tubes were used as replacement and the life was increased from 3 to 5 months.

Service Conditions: Tube interior: Gas oil having 0.6 to 0.8 percent organic sulfur compounds. Tube exterior: Depropanized naphtha containing 0.035 to 0.10 percent organic sulfur including 4-40 mg RSH/100 cc plus trace of H_2S. Temperature: 350°-600° F. (Ave. 450° F.) Operating Pressure: 225 psi inside tubes and 40 psi outside. Aeration: None.

Discussion: Depropanized naphtha per se is not considered to be particularly corrosive even at elevated temperatures and, therefore, the problem resolves itself into a consideration of the effect of the organic and inorganic sulfur compounds in promoting corrosion of mild steel and Muntz metal. No quantitative test data were available under the actual service conditions described but an opportunity was provided to expose some specimens of various metals and alloys on our standard spool-type specimen holders in naphtha contained in the sump of the top tray of a topping unit and in the bottom of a fractionating bubble tower wherein sulfur compounds were present at elevated temperatures and it is believed that these conditions are somewhat analogous to the problem

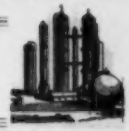


TABLE 1

MATERIAL	Indicated Corrosion Rate-Inch Penetration per Year		
	Test 1	Max. Pitting During Test-In.	Test 2
Monel	0.0003	None	*
Nickel	<0.0001	None	*
Inconel	0.0001	0.003	0.0022
Types 302 & 304 S.S.	0.0001	0.008	0.0003
Type 316 S.S.	<0.0001	0.006	
Mild Steel	0.0031	0.021	0.144
Type 302 S.S.	.....	.....	0.017
Type 410 S.S.	.....	.....	0.0015
Red Brass	.....	.....	*
Admiralty Metal	.....	.....	0.0059

* Specimens, originally 0.031 inch thick were completely destroyed during test period.

application to indicate the probable suitability of other materials for the service in question. The test conditions and results are given below:

Test 1—Specimens exposed for 538 days in sump of the top tray of a topping unit to naphtha containing 0.008 percent sulfur plus traces of H_2O and H_2S. The temperature varied between 290° and 360° F. with an average of 320° F. and the velocity was 6 inches per second.

Test 2—Specimens exposed for 75 days in bottom of fractionating bubble tower handling oil with a sulfur content of 0.751 percent and a boiling range of 164° F. to 600° F. at normal pressure. The temperature varied between 675° F. and 700° F. with and average of 690° F. Aeration was nil and agitation was turbulent. See Table 1.

The data from Test 1 indicate that while the general corrosion resistance of mild steel is of a satisfactorily low order, it has a strong tendency to suffer severe localized attack in the form of pitting. The chromium containing materials such as Inconel and the austenitic stainless steels also showed the same tendency but to a much lesser degree. Monel and nickel were free of this type of attack and in addition showed negligibly low overall corrosion rates based on weight loss at this temperature.

In Test 2 none of the specimens showed any evidence of pitting attack but it will be observed that mild steel was subject to a high rate of corrosion. Monel and nickel cannot be considered for the application because as shown by the data in this test they are susceptible to severe general and intergranular attack by sulfur compounds at temperatures much in excess of 500° F. It was mentioned that Muntz metal tubes were substituted for mild steel and that an additional 3 to 5 months life was obtained. It was not reported how these tubes failed but if it was caused by dezincification, there is a good possibility that inhibited Admiralty metal will give greatly superior performance since its general corrosion rate in Test 2 was only 0.0059-inch per year. Another material worthwhile considering is Type

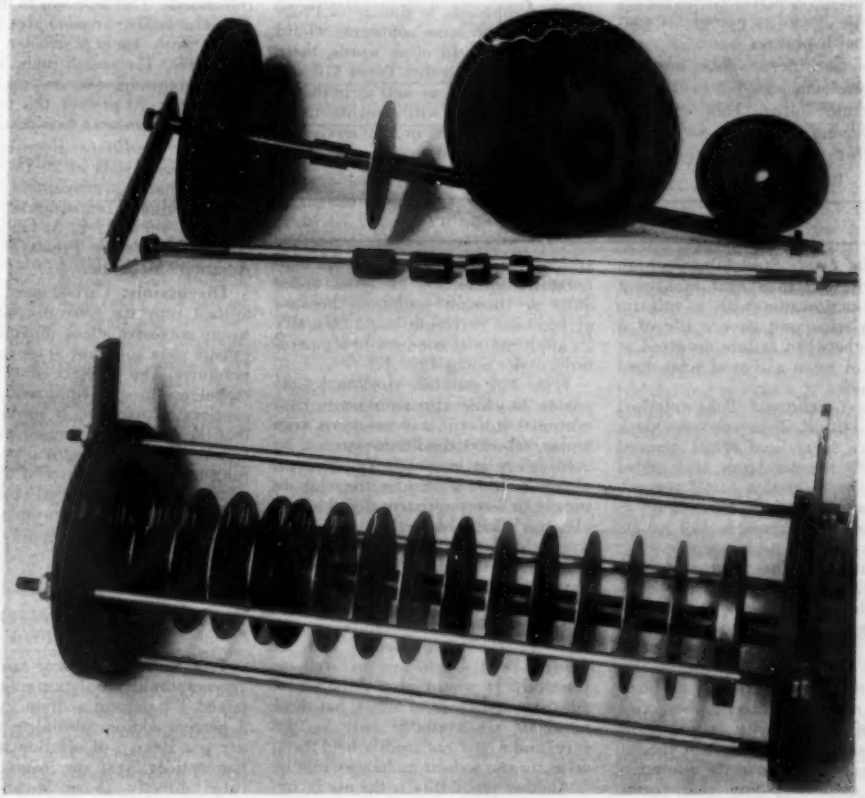


Figure 1. Spool-Type Specimen Holders Used by Inco in Tests.

502 stainless steel which showed a superiority over mild steel of about 10 to 1. By increasing the chromium content to 13 percent (Type 410 stainless), the ratio is extended to approximately 100 to 1. It seems that the latter materials would probably represent the more economical investment.

The accelerated corrosion that occurred on the steel tubes where they passed through the baffle plates was in all probability caused by concentration cell corrosion of the metal-ion type. In practice, these cells are usually set up by differences in the rate of movement of the corroding solution, or, more effectively, by movement of one part of the solution while another part remains practically stationary. In this way, the stagnant portion in the crevice between the tubes and baffle plates became saturated with products of corrosion, or metallic ions, while the moving portion sweeps them away leaving the solution low in concentration of corrosion products. This condition sets up a flow of electric current which causes galvanic or accelerated corrosion of the metal in the region where a relatively low ion concentration is maintained, that is at the edge of the juncture of the tubes and baffle plates.

Problem 2

Material Used: Steel tubes with an 0.095-inch wall in a heat exchanger used in combined distillation and cracking service gave a life of 12 months when pitting occurred on the outside surface and accelerated corrosion where the tubes passed through the steel baffle plates.

Service Conditions: Tube interior: Crude petroleum with 0.3 to 0.5 percent organic sulfur. Tube exterior: Gas oil having 0.6 to 0.8 percent organic sulfur compounds. Temperature: —10° to 650° F. (Ave. 450° F.) Operating Pressure: 225 psi inside tubes and 300 psi outside. Aeration: None.

Discussion: This case of pitting and corrosion of the outside of the tubes by gas oil containing organic sulfur compounds is similar to Problem 1 and the same comments would seem to apply. In other words, there is every indication that Types 410 and 502 stainless steel as well as inhibited Admiralty Metal will provide much better performance in the service in question than mild steel.

Problem 3

Material Used: Steel tubes with an 0.095-inch wall in a heat exchanger used in conjunction with a sulfuric acid alkylation unit gave a life of 3 to 4 months when failure occurred at junction of tubes and steel tube sheet on acid side.

Service Conditions: Tube interior: steam at 140 psi. Tube exterior: black alkylation spent acid 89.91 percent H_2SO_4, 98 percent fresh acid added to bring concentration to 92 percent. Temperature: 300° F. Max., 200° F. Ave. Operating Pressure: 140 psi inside tubes and 65 psi outside.

Discussion: The point of failure is typical of concentration cell corrosion of the metal ion type as discussed in Problem 1. High concentrations of sulfuric acid over about 80 percent and low moderate temperatures are favorable for the satisfactory performance of mild steel except where conditions of high velocity or turbulence are encountered. The effect of the latter forces is to remove the protective ferrous sulfate coating that forms. However, it generally is not practical to use mild steel with concentrated sulfuric acid solutions at elevated temperatures up to 300° F. even under quiet or stagnant conditions because of excessive corrosion attack. Usually its application is confined to temperatures under about 120° F.

Type 316 stainless steel and Carpenter 20 while also resistant to concentrated sulfuric acid solutions even under velocity conditions cannot be used safely at temperatures in excess of about 180° F. Under the circumstances, it seems apparent that the only material that might be considered worthwhile for the application in question is Hastelloy B, which is reported to have fair resistance to corrosion by concentrated solutions of sulfuric acid at temperatures up to 300° F. The silicon irons, such as Duriron and Durichlor, as well as Hastelloy D would also demonstrate adequate resistance to attack but these materials are available only in cast form and would not readily lend themselves to use as heat exchanger tubing.

Another possibility is the use of impervious graphite tubing but this material is somewhat brittle and care must be exercised in the handling of it. Apparently since the corrosive conditions are so severe and the availability of materials in wrought form is rather limited for tubular elements in a heat exchanger, it might be considered practical to redesign the unit along the lines of the standard sulfuric acid concentrators in refineries where the evaporator bodies usually are of steel, lined with lead and this covered with acid resistant brick. The heater tubes or thimbles commonly are of Hastelloy D and other parts of Duriron, Corrosiron and carbon are used.

Problem 4

Material Used: Carbon steel lye regeneration tower with cast iron trays and bubble caps. The steel distributor pipe on the unregenerated lye inlet was completely corroded away and was replaced with a splash plate located 4 feet from the nozzle or 1 foot from the opposite side of the tower. A hole 1/16-inch in diameter developed in the tower shell directly opposite the inlet nozzle. This hole was in the upper part of a badly corroded area 6.5 x 10 inches with lesser corrosion over a large area. The splash plate had been corroded through over an area 8 inches in diameter. At present, this tower has been in service over two years.

Service Conditions: Regeneration of lye or caustic soda of 20°Be (15 percent) containing mercaptans and hydrogen sulfide. Temperature: At bottom of tower 270° F. At top of tower 240° F. Operating Pressure: 20 psi. Aeration: Moderate.

Discussion: Carbon steel as well as cast iron are generally subject to severe corrosive attack in contact with caustic soda solutions at elevated temperatures. The presence of velocity or turbulence in such equipment tends to accelerate corrosion. It seems evident that the latter effect caused premature failure of the distributor pipe and impingement attack shortened the life of the area in the tower shell opposite the inlet nozzle as well as the splash plate.

Given below are the results of some plant corrosion tests in caustic regeneration units:

Plant Corrosion Tests in Caustic Regeneration Units

Test A—In reboiler of caustic soda regenerator unit. Solution entering contained 1-2 percent sodium hydroxide, 3 percent sodium phenolate and 0.07 mg. per 100 c.c. of solution as sodium mercaptides. Test specimens were located directly above Monel heating tubes. Temperature 255° F. Duration of test 131 days.

TABLE 2

MATERIAL	Corrosion Rate Inch per Year			
	Test A	Test B	Test C	Test D
Monel	.001	.002	.003	.002
Nickel	.024	.002	.022	.016
Inconel	.0001	.0003	.001	.002
Mild Steel	.020	.033	*	.012
Ni-Resist (Type 1)	.023	.013	.046	.019
Cast Iron	.017	.....	.040	.014

* Specimens completely destroyed during test, original thickness of specimens 0.062 inch.

Test B—In vapor section of caustic soda regeneration unit. Solution entering contained 13.2 percent sodium hydroxide, 0.37 percent sulfide sulfur and 0.80 percent mercaptide sulfur. The average temperature was 300° F. The duration of the test was 55 days.

Test C—In reboiler of caustic potash regenerator unit. Solution entering contained 25.5 percent potassium hydroxide, 37.8 percent potassium isobutyrate, 5.5 percent potassium sulfide, 1.9 percent potassium mercaptides and 2.1 percent potassium carbonate. Test specimens were located in boiling liquor at upstream side of overflow weir. Average temperature 286° F. Duration of test 140 days.

Test D—Same as "C" above except test specimens were exposed in vapor at downstream side of overflow weir. Average temperature 286° F. Duration of test 140 days. See Table 2.

It will be noted that in one test mild steel specimens, originally 0.062-inch thick, were completely destroyed in 140 days while in the other three tests the corrosion rates of the material were of a relatively high order. Monel and Inconel gave outstanding performance and as a matter of fact Monel is being rather widely used in the petroleum industry for caustic soda regenerator reboilers and tubes, for lining the bottom sections of regenerator towers and for pumps, piping and preheaters handling the hot solutions. Inconel has also proved to be a useful material for evaporator tubes or other parts of regenerator systems and should be used rather than Monel in this service where metal temperatures in excess of 500° F. are encountered since Monel is subject to sulfur embrittlement at higher temperatures.

In view of the difficulties described with mild steel and the proved outstanding performance of Monel under such conditions, it was suggested that the affected parts of the tower be replaced or lined with Monel.

Problem 5

Material Used: Carbon steel piping, 10-inch diameter x ½-inch wall in a crude flash tower handling Quiriquire crude suffered a loss of 3/32-inch in a year accompanied by severe pitting and a gouging effect.

Service Conditions: The crude is charged to the flash tower at a rate of 25,000 W.G. per hour and at a viscosity of 400 sec. at 100° F. Saybolt. The crude is reported to contain organic acids (naphtenic acids), chlorides and sulfides. Temperature: 580°-630° F. (Ave. 600° F.) Operating Pressure: 15 psi. Aeration: None.

Discussion: Naphtenic base crudes such as Quiriquire and Monaca, have proved to be highly corrosive at elevated temperatures. Some plant corrosion tests have been made in the processing of these crudes and the following data have been obtained.

Test 1—Specimens exposed for 17.5 days in a 2nd stage separator of a combination unit handling cracked petroleum gas oil from Monaca crude containing combined sulfur up to 1.27 percent as H_2S, mercaptans and organic sulfides. The temperature was 750°-780° F. with an average of 760° F. and the flow varied between 17,000 to 21,500 W.G. per hour through a 6-inch pipe size line.

Test 2—Specimens exposed for 196 days in a first stage intercondenser of a combination unit handling cracked petroleum reduced crude containing up to 1.1 percent sulfur as H_2S, mercaptans, plus organic sulfides. For 131 days Monaca crude was being processed during the test and for 65 days Quiriquire crude. The temperature was 790°-820° F. with an average of 800° F. and the flow varied between 16,000 to 18,000 W.G. per hour through a 12-inch extra heavy pipe. See Table 3.

The temperature conditions of the tests are somewhat higher than in the problem application but the data might serve to indicate the relative behavior of the various materials investigated. It will be observed that in Test 1 mild steel showed a corrosion rate of 0.095 inch per year which is almost identical with the 3/32-inch loss per year reported for the 10-inch piping in the service in question. Apparently, some improvement of the order of 3 to 1 would be provided by the substitution of Type 502 stainless steel and, of course, the higher chromium content alloy, Type 430, as well as the austenitic stainless steels and Inconel would give superior performance. It should be noted the powerful effect sulfur compounds at elevated temperatures, above 500° F. have on Monel and nickel in causing accelerated corrosion.

TABLE 3

MATERIAL	Indicated Corrosion Rate-Inch Penetration Per Year	
	Test 1	Test 2
Monel	0.238	*
Nickel	0.232	*
Inconel	0.0074	0.0002
Type 302 S.S.	0.0042	0.0023
Type 316 S.S.	0.0037	0.0022
Type 430 S.S.	0.0060	0.0003
Type 302 S.S.	0.030	0.0071
Cast Iron	0.043	0.054
Mild Steel	0.095	0.027

* Specimens originally 0.031 inch thick were completely destroyed during test period.

Problem 6

Material Used: 10 pounds lead on walls and 14 pounds lead on cones of steel shell light fuel oil agitators. The lead lining on the walls is replaced every 5-6 years and the lining on the cone shaped bottoms every 3-5 years. The agitator roofs are replaced approximately every 3 years. Considerable patching is required during the life of the linings and corrosion of the underlying steel shell occurs through holidays in the linings.

Service Conditions: Treating light fuel oils with one of the following: 93-98 percent H_2SO_4, 2-10 percent sodium hydroxide and 19-25 percent sodium plumbite solution. In addition the oils contain mercaptan sulfur, elemental sulfur and polysulfides. During acid treating the batch is agitated with air for 15 minutes, and during lye treating the batch is agitated with air for 6 to 12 hours. It was also reported that the batches contained small quantities of elemental sulfur and lead sulfides as suspended solids and that a maximum copper pickup from the equipment of 0.5 ppm copper can only be tolerated. The temperature of the acid batch varies between 65° and 95° F. with an average of 75° F. and of the lye batch between 120° and 130° F. with an average of 125° F.

Discussion: In these batch operations the same vessel was used for acid washing, neutralization and "doctoring" for removal of traces of mercaptans. A plant corrosion test was made in a batch vessel in which the acid treatment, water washing and caustic treatment were all carried out in the same unit and agitation was done with air. Given below are the test conditions and the results ob-

tained together with some data from a sodium plumbite solution:

Test 1—Specimens immersed 3 feet above bottom of cone in fuel oil treating tank during treatment with 4 pounds per barrel of 66°Be sulfuric acid followed by water washing and treatment with 10°Be Caustic soda. Agitated with air. Temperature 80°-105° F. Duration of test 56 days.

Test 2—Specimens installed in an agitator and immersed in sour gasoline, mixed with a sodium plumbite solution for the removal of mercaptans and H_2S. Moderate aeration and high agitation. Temperature 60-80° F. (Ave. 70° F.). Duration of test 150 hours actual operation but spool was installed for 125 days. See Table 4.

The data from Test 1 indicate that Hastelloy A was the best of the materials tested, followed by Worthite, Inconel and Monel. It should be mentioned that Monel is being widely used in this service particularly where mechanical agitation is employed. Air agitation increases somewhat the corrosion rate of Monel during the acid treating cycle, although it is not excessive because of the relatively short time of contact of only 15 minutes with the media during the cycle. While Inconel showed comparable corrosion resistance with Monel in the test we would prefer to see the latter material used in such service because of its better reliability in contact with dilute solutions of sulfuric acid. In practice, while concentrated sulfuric acid is added to the oil batch, it is readily diluted down by picking up water from the oil and usually must be further diluted with water to accomplish good separation of the acid sludge after treatment, so that water solutions of acid concentration down to 5 or 10 percent may be encountered in the separation systems. Monel is not resistant to attack by sulfuric acid solutions in excess of about 80 percent concentration at atmospheric temperature and when 66°Be acid is added to an oil batch care is exercised to avoid any contact of it with the side walls of the Monel vessel until it has had a chance to mix with the oil.

TABLE 4

MATERIAL	Test 1	Indicated Corrosion Rate-Inch Penetration Per Year Test 2	
		Based On 150 Hours	Based On 125 Days
Monel	0.018	0.0002	<0.0001
Nickel	0.037	0.0002	<0.0001
Inconel	0.016	0.0001	<0.0001
Worthite	0.012	.....	.....
Hastelloy A	0.003	.....	.....
Chemical Lead	0.038	0.073	0.0037
Type 1 Ni-Resist	0.036	0.0008	<0.0001
Cast Iron	0.056	0.012	0.0006
Mild Steel	0.021	0.010	0.0005

The Hastelloy alloys are rather expensive and in the event this might eliminate them from consideration, the next most logical replacement material for chemical lead is Monel, which based on the test results should give better than twice the life of the present equipment without the necessity of continual patching. The ultimate performance of Monel could be considerably improved by providing mechanical agitation instead of air agitation during the acid washing cycle, thereby also reducing the amount of copper pick-up to a minimum.

In referring to Test 2 wherein the corrosive was sour gasoline mixed with a sodium plumbite solution it will be noted that lead was the poorest of the materials tested and it is this metal of which the equipment was constructed. Here again, the indications are that Monel would probably represent the most practical and economical material to use in this particular service. For cast equipment such as pump bodies and valves, Ni-Resist would seem to be an excellent choice as it showed up to be more than ten times better than cast iron as well as mild steel.

Problem 7

Materials Used: 12-inch extra heavy carbon steel pipe with ½-inch wall used as a tube and tank cracking coil failed in 1½ to 2 years due to general corrosion by vapors in bends leading from the top of the separator to the high pressure exchangers.

Service Conditions: Pipe handles reduced crude vapor containing mercaptans, H_2S, free sulfur, SO_2 and chlorides. Temperature: 730°-740° F., Ave. 735° F. Operating Pressure: 70 psi. Aeration: None.

Discussion: The change in flow of the vapors in the pipe at bends evidently sets up a more or less turbulent condition at these locations which causes accelerated corrosion of steel through the mechanism of removing or preventing the formation of protective corrosion product films. No data were available to illustrate the effect of velocity on steel in the service in question but the following plant test data were obtained under turbulent conditions and they will give some idea as to what materials might be used to better advantage by providing additional corrosion resistant insurance.

Test 1—Specimens exposed in cracking coil fractionator for 197 days to reduced crude oil having an average sulfur content of 0.21 percent and an average API gravity of 29. Temperature: 700°-720° F., Ave. 715° F. Aeration: None. Agitation: Turbulent.

Test 2—Specimens exposed in cracking coil fractionator for 122 days to reduced crude oil vapors having an average sulfur content of 0.6 percent. Temperature: 575°-600° F., Ave. 590° F. Aeration: None. Agitation: Turbulent. See Table 5.

TABLE 5

MATERIAL	Indicated Corrosion Rate-Inch Penetration Per Year	
	Test 1	Test 2
Monel	*	*
Nickel	*	*
Inconel	0.0008	0.0015
Type 302 S.S.	0.0001	0.0004
Type 410 S.S.	0.0006	0.0015
Type 502 S.S.	0.0033	0.0051
Hastelloy A	0.0002	0.0004
Mild Steel	†	0.018
Type 1 Ni-Resist	0.058	0.025
Cast Iron	0.052	0.024

* Specimens originally 0.031 inch thick, were completely destroyed during test period.

† Specimens originally 0.062 inch thick, were completely destroyed during test period.

The data indicate that under some conditions mild steel can suffer exceedingly high rates of attack and if you will refer to Test 1 you will note that specimens of this material, originally 0.052-inch thick, were completely destroyed during the exposure period of 197 days. Under the same conditions Type 502 stainless steel gave very satisfactory performance and would seem to be the most practical and economical material to use to replace the present steel piping. There does not appear to be any necessity in going to the more highly alloyed and more expensive materials for the service in question.

Problem 8

Material Used: Carbon steel propane (cracked distillate) accumulator with an acid-proof cement lining (Vitric No. 10). It is reported that general corrosion and severe pitting occurs with a loss of about 1/64-inch per year.

Service Conditions: Two phases in accumulator: Liquid Phase—Small percentages of sulfides and chlorides having an acidity of 1.0 mg. of KOH per gram with an average pH of the water settlement 4.4. Gas Phase—Petroleum gas containing methane, ethane, propane, butane and a small

percentage of H_2S. Temperature: 75°-90° F., Ave. 80° F. Operating Pressure: 60 psi. Aeration: None. Agitation: 8000 W.G. of distillate charge per hour.

Discussion: We presumed that corrosion of the steel beneath the coating occurred through porosity or bare spots that were not covered initially. The corrosion was evidently caused by hydrolysis of the chlorides to form small amounts of hydrochloric acid. While no data were available from a propane accumulator some were developed in a rerun gasoline condensate accumulator and in a reflux water separator where the water layers contained some HCl and H_2S. The test conditions and results are given below:

Test 1—Specimens exposed for 59 days in a rerun gasoline condensate accumulator where the water layer contained some HCl and H_2S. The pH of the water varied from 2.1 to 6.5 and the temperature 70°-95° F. with an average of 88° F. There was no aeration but the velocity was 0.67 feet per second.

Test 2—Specimens exposed for 414 days in a reflux water separator where the water layer contained some HCl and H_2S. Average temperature was 120° F. See Table 6.

The rate of corrosion exhibited by mild steel in Test 1 is much higher than the rate reported of about 0.015-inch per year which, incidentally, does not appear to be intolerable. The results from Test 2 appear to be more in line with the problem conditions and it should be pointed out that if something better than mild steel is required for the 10 ft. x 30 ft. accumulator in question that Monel or nickel in the form of lining or clad on steel be used. While the chromium containing materials including Inconel and Types 302, 410, and 502 stainless steel also showed usefully low corrosion rates they were subject to pitting attack and in view of their known tendency in this respect when used in contact with halogen salts or solutions, we would hesitate to suggest their use in the problem application.

TABLE 6

MATERIAL	Indicated Corrosion Rate-Inch Penetration Per Year	
	Test 1	Test 2
Monel	0.0015	0.0019
Nickel	0.0023	0.0028
Inconel	0.0004	0.0002[1]
Type 302 S.S.	0.0005	0.0001[2]
70/30 Cu-Ni	0.011	.....
Mild Steel	0.056	0.018
Type 410 S.S.	.....	0.0009[3]
Type 502 S.S.	.....	0.0061[4]

[1] Pitted to a maximum depth of 0.003" during test period.
[2] Pitted to a maximum depth of 0.015" during test period.
[3] Pitted to a maximum depth of 0.010" during test period.
[4] Pitted to a maximum depth of 0.018" during test period.

Problem 9

Material Used: Carbon steel for tower top, 70-30 for condenser tubes, Monel for condensate drum lining, carbon steel for transfer lines and for run down tank. It is reported that general corrosion and pitting of some of the materials is occurring but life seems to be indefinite.

Service Conditions: Mixture of light naphtha and water bearing H_2S and some HCl with pH controlled to 6.5 to 7.5 by addition of anhydrous ammonia. Temperature: 80°-110° F., Ave. 95° F. Operating Pressure: 10 psi. Aeration: Moderate. Agitation: Turbulent in lines—quiet in drums.

Discussion: While some light general corrosion and pitting are being encountered with the various materials in this service, it does not appear based on plant corrosion tests that their lives will be premature. As an example, tests made in the water settling section at the bottom of a gas separator taking the overhead from a rerun tower handling gasoline and water from crude naphtha from Oficina (50 percent), Louden (38.3 percent) and Mid-Continent (11.7 percent) crude oils show negligible corrosion rates for the materials in question. The test was run for 194 days at a temperature varying between 70°-112° F. with an average of 98° F. and the results obtained show in Table 7.

It is evident that mild steel has a reasonably useful corrosion rate while Monel and 70/30 Cu-Ni are highly resistant to corrosion. It was indicated in the report of the problem that steel has a life of 10 years while that of Monel and 70/30 is indefinite. The data would seem to bear this out and

TABLE 7

MATERIAL	Indicated Corrosion Rate-Inch Penetration Per Year
Monel	0.0008
Nickel	0.0007
Inconel	0.0001*
70/30 Cu-Ni	0.0031
Types 302 and 304 S.S.	<0.0001
Type 316 S.S.	<0.0001
Type 410 S.S.	0.0005†
Type 502 S.S.	0.0043
Type 1 Ni-Resist	0.0020
Mild Steel	0.0090
Cast Iron	0.0078

* Pitted to a maximum depth of 0.004" during test period.
† Pitted to a maximum depth of 0.006" during test period.

what little pitting has been observed in practice is probably not of the serious and penetrating type that leads to untimely failure.

Problem 10

Materials Used: Carbon steel, ½-inch thick used for stack on process furnace employed in the fractional distillation of naphtha. In 10 months corrosion had destroyed the metal at one point near the base completely around the stack. Repairs were made to stack by welding 6-inch I beams as stiffeners around the base plus an interior lining over the corroded area. In another 12 months repairs were again made as corrosion had attacked the weld metal on the interior of the stack.

Service Conditions: Flue gas containing a high content of SO_2 and SO_3. Temperature: 60° F. at base of stack to 500° F. Operating Pressure: Atmospheric. Aeration: Complete. Agitation: Turbulent.

Discussion: The temperature at the base of the stack is below the dew point of the gas and as a result some sulfurous acid is formed which is oxidizing in nature and highly corrosive to carbon steel. The results of a corrosion test made under sulfurous acid conditions at atmospheric temperature are given in Table 8.

TABLE 8

MATERIAL	Indicated Corrosion Rate-Inch Penetration Per Year
Monel	0.006*
Nickel	0.007*
Inconel	0.0020*
Type 302 S.S.	<0.0001†
Type 304 S.S.	0.0002†
Type 316 S.S.	<0.0001
Mild Steel	0.011

* Specimens, originally 0.081" thick, were perforated during test period.
† Specimens of these materials were pitted to a maximum depth of 0.012", during test period.

While in this test the corrosion rate of mild steel is not very high, nevertheless, it has been observed to corrode at a more rapid rate under similar circumstances. Type 316 S.S. proved to be the best of the materials tested and from a practical standpoint it has worked out to be one of the most suitable alloys that may be used in contact with dilute sulfurous acid solutions. Almost without exception Monel, Nickel, Inconel and the straight 18-8 types of stainless steel suffer localized

attack in the form of pitting in this type of service.

Problem 11

Material Used: Carbon steel tower, lines and pump used in the fractional distillation of naphtha. General corrosion and pitting of steel occurs particularly at the liquid level in the tower and in pump casings. It is reported that the bottom of the tower was lined with stainless steel about a year ago and the impeller in one pump was replaced with 4-6 percent chrome steel.

Service Conditions: Hot cracked naphtha containing H_2S with traces of water. Temperature: 600°-625° F. Operating Pressure: 100 psi. Aeration: None. Agitation: Turbulent.

Discussion: Here again, the corrosive conditions must be considered to be similar to Problem 1. As mentioned previously cracked naphtha has not proved to be active in promoting corrosion of metal and alloys and, therefore, our concern lies with the effect of sulfur or sulfur compounds at elevated temperatures on materials of construction. It was shown in the tests listed under Problem 1 that mild steel can be subjected to high rates of general attack as well as severe pitting in contact with naphtha and/or gas oil containing organic sulfides and traces of water at temperatures between 290° and 690° F. The available data indicate that the use of 18-8 stainless steel was a wide choice for the lining of the bottom section of the tower where maximum corrosion was encountered with mild steel. It is further indicated that the substitution of Type 502 stainless steel for the impeller is a move in the right direction and it would seem practical to consider using this material for the pump casings as well. Of course, if somewhat better service life is desired over the expected performance of the Type 502 alloy, without going all the way to the use of the austenitic stainless steels, Type 410 should be considered since the corrosion test results indicate a definite superiority of about 10 to 1.

Problem 12

Material Used: Carbon steel used for vacuum tower, overhead vapor line and vacuum condensate transfer line in the fractional distillation of crude oil. Steel suffers general corrosion and pitting. Vitric acid proof cement is used as a lining in the tower but it breaks up exposing the underlying steel to corrosion. The shell from trays 7 to 16 is very close to the limiting thickness and Type 347 stainless steel has been applied as a lining at Trays 10 and 11. About five of the remaining sections will be in need of relining either with vitric acid proof cement or with stainless steel in the very near future.

Service Conditions: Gas oil mixed with water containing H_2S plus some chlorides at a pH of 2.0 to 5.0. Temperature: 70°-100° F. (Ave. 80° F.) Operating Pressure: Atmospheric. Aeration: Moderate. Agitation: Turbulent.

Discussion: The acidity of the gas oil-water mixture is in all probability due to hydrolysis of the chlorides that are present with the formation of small amounts of hydrochloric acid. Corrosion by such conditions was discussed under Problem 8 and data were presented to show the effects of this mineral acid on the performance of various metals and alloys in a rerun gasoline condensate accumulator where the pH of the water layer varied between 2.1 and 6.5 and in a reflux water separator where acid conditions also prevailed.

It was shown in these tests that steel can suffer relatively high rates of attack and that there are other materials available that are better suited for the application, namely Monel and nickel. These materials have proved to be outstanding in their resistance to corrosion by dilute solutions of hydrochloric acid and the best practical example that may be cited of the use of Monel, in particular, in petroleum refineries is for the lining of the top sections of crude oil fractionating towers where temperatures below 500° F. are encountered and corrosion by hydrochloric acid conditions must be provided against.

Neither the austenitic stainless steels nor the straight chromium varieties are employed in this service because of their generally known and proven susceptibility toward pitting attack and the test data from the reflux water separator bear this out quantitatively by the pitting measurements that have been made on specimens of these materials after an exposure of 414 days.

Based on the evidence at hand and practical experience, it would seem more logical to consider the use of Monel or nickel instead of Type 347 stainless steel for relining the remaining five sections of the tower and also for overhead vapor lines and vacuum condensate transfer lines.

Problem 13

Material Used: Carbon steel used for debutanizing tower top, overhead lines, fittings and reflux condensate drum. In 1949 corrosion in the top head of the tower caused a metal loss of 1/32-inch per year and in the shell from 1/64 to 3/64-inch per year. More recently there appears to be a considerable increase of corrosion over that of previous years. The metal loss in the top head of the reflux drum was 1/32-inch per year and in the shell and bottom head 1/64-inch per year. It was also reported that the debutanizer tower overhead and reflux lines both show a corrosion rate of 1/64-inch per year.

Service Conditions: Light naphtha mixed with water containing H_2S and some HCl at a pH of 2.0 to 5.0. Temperature: 250° F. at top of tower — 70° F. in reflux drum. Operating Pressure: 60 psi. Aeration: None. Agitation: Turbulent.

Discussion: This problem should be considered along with Problem 8 and 12 wherein corrosion by hydrochloric acid, the most active constituent in the mixture, is the principal cause of the deterioration of the steel equipment. As mentioned previously, it is not generally good practice to use the austenitic stainless steels or the straight chromium types under such conditions because of pitting tendencies and especially at the top of the debutanizer tower where the maximum temperature is 250° F. since it would be expected that the localized attack would be seriously increased. Under the circumstances, therefore, it would be suggested that Monel or nickel be considered for the service in question especially since they have proved over the years to be the most suitable and practical materials to use in somewhat similar or comparable applications.

Problem 14

Material Used: Steel regenerating tower used in a fufural recovery system.

Service Conditions: Furfural and water at 360° F. Severe corrosion of mild steel above the vapor line at each tray level in less than a year's time rendered the tower useless and required the installation of a lining.

Discussion: Under some conditions it has been found that the decomposition products of furfural at

elevated temperatures can be highly corrosive to steel and the following data obtained in a furfural extract separation tower tend to verify this experience. Specimens were exposed for 122 days in the downpour between the bubble trays in the tower where the temperature of the furfural averaged 450° F. There was no aeration but some agitation was reported due to flow of the extract. See Table 9.

The data indicate that chemical lead, mild steel and Type 410 stainless steel are apparently unsuitable for use under the particular test conditions because of their tendency to suffer severe localized corrosion. All of the other materials investigated showed an absence of this form of corrosion and at the same time showed negligibly low rates of general attack. Under the circumstances, therefore, it would appear practical to select one of these as a lining material to protect the steel tower in question which is doomed to premature failure.

TABLE 9

MATERIAL	Indicated Corrosion Rate-Inch Penetration Per Year	Maximum Pitting During Test-Inch
Monel	<0.0001	None
Nickel	<0.0001	None
Inconel	<0.0001	None
Type 302 Stainless Steel	<0.0001	None
Type 316 Stainless Steel	<0.0001	None
Chemical Lead	0.0026	Perf.*
Type 410	0.0014	0.012
Aluminum 28	0.0002	None
Type 502 Stainless Steel	<0.0001	None
Mild Steel	0.0112	Perf.*
Ni-Resist	<0.0001	None
Cast Iron	0.0001	None

* Specimens of these materials were originally 0.062 inch thick.

The author has had some firsthand experience with a Monel-lined furfural treating tower equipped with Monel internals and a recent checkup on this installation indicates that it is still in satisfactory condition after better than 12 years service.

Problem 15

Material Used: Steel straight run fractionating tower and trays. The trays were ⅜-inch thick and lasted only a year and the shell was severely pitted after two years. The severest condition occurred in the uppermost section of the tower.

Service Conditions: Crude oil being processed with a gravity of 20 to 26. The sulfur content varied from 1.3 to 2.5 and the salt content from 15 to 30 pounds per 1000 barrels. The total sulfur in the gasoline varied from 0.12 to 0.40 percent. The temperature at the top of the tower was maintained at 300° to 340° F. and 18 percent gasoline was being produced.

Discussion: Corrosion in the top sections of atmospheric crude distillation units arises chiefly from hydrochloric acid either formed by hydrolysis of chloride salts, especially calcium and magnesium chloride, entrained in the crudes, or added by the acidizing of wells. Despite the customary practice of settling the salt water from crudes, and in some cases the use of special desalting processes, there still appears to be enough salt water dispersed in such crudes to result in the formation of an acid condition. Corrosion is mitigated in some cases by injection of ammonia into the distillation system to neutralize part of the acid, but experience would indicate that this frequently is not an adequate solution to the problem.

It is probable that with salty charging stocks, maximum hydrolysis of magnesium and calcium chlorides occurs in the hottest region at the bottom of distillation towers. However, maximum acid corrosion occurs in the top portion of such towers, in reflux and distillate condensers, coolers and accumulators, and in reflux and run-down lines, where temperatures are low enough for an aqueous acid phase to condense. Maximum corrosion by sulfur compounds will, on the other hand, occur in the higher temperature ranges in the bottom portions of distillation towers and in crude heaters. As the alloys most resistant to acid corrosion frequently are not resistant to high temperature sulfur attack, it is common practice to line the top and bottom portions of distillation towers with different materials to obtain most favorable performance.

Numerous corrosion tests have been made on or above the top plate of atmospheric crude distillation towers in a number of refineries in different geographical locations and the following results are typical of those representing probably some of the worst conditions involving the processing of West Texas crude. The specimens were exposed for 60 days to the straight run gasoline vapor at the top of the tower maintained at an average temperature of 250° F. See Table 10.

TABLE 10

MATERIAL	Indicated Corrosion Rate-Inch Penetration Per Year	Maximum Pitting During Test-Inch
Monel	0.0031	None
Nickel	0.0057	0.013
Inconel	0.017	0.016
Type 302 Stainless Steel	*	....
Type 304 Stainless Steel	*	....
Type 316 Stainless Steel	0.053	0.001
5% Nickel Steel (SAE 2512)	*	....
Mild Steel	*	....
Ni-Resist	0.051	None
Cast Iron	0.181	Graphitized

* Specimens of Types 302 and 304 stainless steel and 5 percent nickel steel, originally 0.031 inch thick, and mild steel, 0.062 inch thick, were completely destroyed during test period.

The test data indicate that mild steel as well as the 18-8 types of stainless steel, 5 percent nickel steel and cast iron are definitely unsuitable under these conditions. It is apparent also that nickel and Inconel are not adequate because of their susceptibility to severe pitting attack. The Type 316 stainless steel showed a reasonable corrosion rate and while the depth of local attack was rather insignificant, this tendency nevertheless exists and it has been noted to be much more serious under similar circumstances. Of the remaining materials, Monel proved to be outstanding from the standpoint of resistance to both general corrosion and pitting. Because of this fact, it has been adopted to a considerable extent as a lining or as a Monel-clad steel shell for upper tower sections, reflux and distillate accumulators and condenser shells, and in some cases for reflux and run-down lines. It is also used for fabricated bubble caps, plates and fittings in upper tower sections.

These problems are typical of many that have been encountered with corrosion of refinery processing equipment and as demonstrated they can often be solved by referring to available information and data obtained by an experienced corrosion engineer under the same or similar conditions. On occasion a situation is involved whereby no clear cut answer to the problem is evident because of the lack of either practical experience and/or available data and under these circumstances it is necessary to resort to the use of spool-type specimen holders for such information as may be obtained. The advantageous use of these assemblies should be encouraged once the details of the problem are established and a check on the sources of existing data discloses no pertinent information under the particular set of corrosive conditions that might be used as a basis for selecting suitable metals and alloys for the environment in question.

* * *

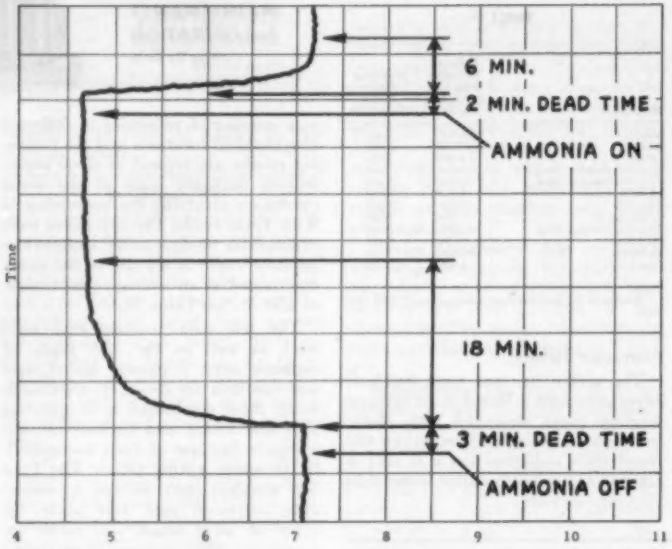


Figure 1. pH Control Test on Crude Unit Overhead Water Drawoff.

IN SPITE of the very extensive literature on the science of instrumentation and control, the instrument man in an operating refinery is constantly confronted with problems on which there is no written solution. In such cases it is necessary that he employ ingenuity in developing new techniques, often utilizing home-made devices to solve his particular problems.

In a unique and practical approach, E. D. Mattix has summarized a number of case histories of control problems which have been solved at the Cities Service refinery in Lake Charles, La. These case histories are typical of refinery control problems and should be invaluable to other instrument men confronted with these and similar situations. This report was presented before the Texas A. & M. Symposium on Instrumentation for the Process Industries, at the Sixth National Instrument Conference in Houston, September 14, 1951.

Refinery Control Problems

E. D. MATTIX

Cities Service Refining Corporation, Lake Charles, La.

Priming Facilities for Unloading Crude from Barges

VARIOUS problems are encountered in unloading crude from barges, the major one of which normally is obtaining and retaining suction on the pump used for this purpose. If a low vapor pressure crude is being unloaded the major problem is encountered when stripping the last crude from the barge as air is pulled into the suction during this period. When a high vapor crude is to be unloaded continuous vaporization occurs in the pump suction line which materially increases the unloading time and costs.

We were recently requested to unload 13-psi vapor pressure crude from barges. It was found that it was practically impossible to pump this high vapor pressure material from the barge because the pump elevation was several feet higher than the elevation of the barge and vaporization occurred in the pump suction. Both centrifugal and reciprocating pumps were available for unloading.

To overcome this problem the suction lines to the pump were streamlined to reduce the pressure drop to a minimum. A vapor separator was installed in the suction of the pump to separate the liquid from the vapor. The vapors were piped to a steam ejector and a liquid level controller with a single-seated control valve was installed in the vapor line ahead of the ejector. This system has performed satisfactorily by reducing the unloading time to one-third of the original and is very desirable on unloading heavy crude as it reduces the stripping time for the barge. The only objectionable feature of this system is a slight oil mist carryover from the ejector.

Due to the success of this system we are planning to remove the reciprocating pumps originally installed for crude unloading and install priming facilities for the other two centrifugal pumps.

pH Control of Crude Unit Overhead Water Draw-offs

pH control instruments, installed on the crude units during the third quarter of 1948, have materially improved the controls of the pH on the water draw-off from these units and, thereby, reduced corrosion on the overhead condensers.

Control instruments with wide throttling range and drift correction were used and each control valve was fitted with a valve positioner. The refinery has a central ammonia storage drum

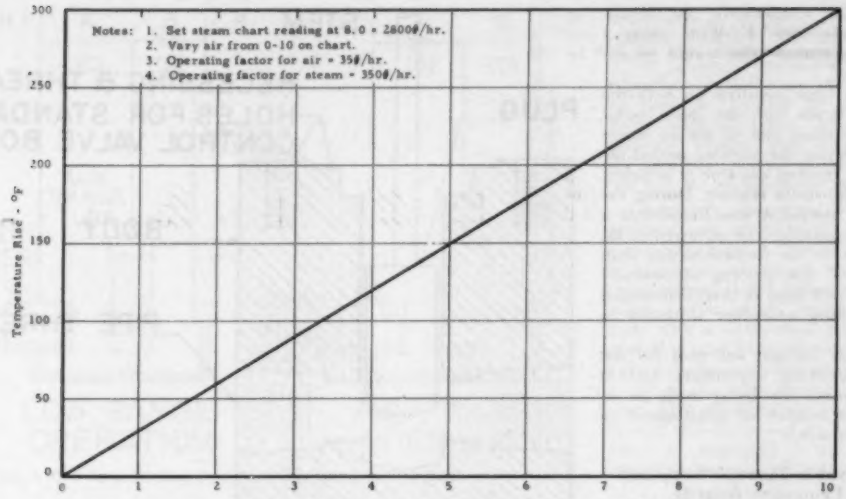


Figure 2. Furnace Decoking Procedure: Theoretical Combustion Temperature Rise for Various Steam-Air Ratios.

which is piped to various units and reduced in pressure to the desired point, then vaporized before the control valve which regulates the ammonia usage to the tower. The ammonia is fed to the vapor line from the kerosine stripper. A sample of water is withdrawn continuously from the gasoline water separator through a separate line direct to the pH cell. A separate line was found necessary, because the liquid level control variations caused slight changes in the pH reading when the sample was taken off the regular water draw-off line.

No difficulty has been experienced with the control of the pH; however, recording of this value presented some difficulty in the beginning. We found that if one man did all the maintenance work on the installation, much better results were obtained, probably because he became more familiar with the equipment. A dry-air bleed was installed in the cover of the pH cell to prevent moisture condensation. It was found that the pH reading was greatly affected by any tower pressure variation due to the change in solubility of H_2S at different pressures.

Figure 1 shows a test made on the installation to determine the dead time and capacity time of the system. All ammonia was shut off and after three minutes dead time the pH started to drop followed by a period of 18 minutes before it reached a minimum value. After several minutes the ammonia was opened up; following this was a two-minute dead time followed by a six-minute capacity time before the pH reading lined out at or near its normal value of seven. The relatively large capacity time in relationship to the small dead time indicates that the process should be controllable.

This test was also conducted manually prior to the installation to determine if the process would be controllable.

Steam-Air Decoking of Furnaces

Much has been written on steam-air decoking of furnaces; however, all these papers indicate that this practice is an art rather than a science. After much debate, it was decided to put in a test installation at our refinery and results indicate that the decoking operation is a science instead of an art.

Calculations indicated that the steam-air ratio should be 10:1 on a weight basis to limit the temperature rise on combustion to 240° F., as the temperature rise is a direct function of the ratio of the percent of oxygen present to the percent of inert material in the steam-air mixture. With pure

Figure 3. Original Installation of Orifice Meter on Air Compressor Suction.

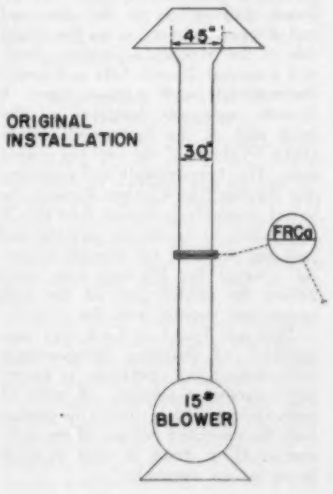
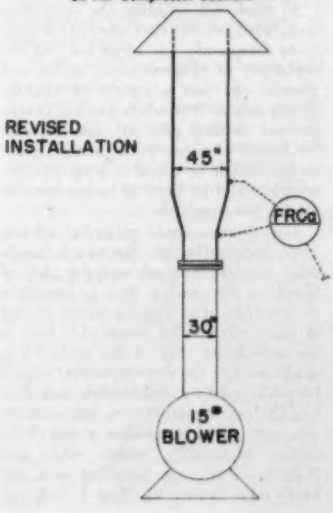


Figure 4. Revised Installation of Venturi Meter on Air Compressor Suction.



oxygen the temperature rise is approximately 4000° F. With steam a 0° F. temperature rise would be expected.

Meters were installed on both the air and steam with the steam meter factor 10 times that of the air meter factor. During the burning period the air meter reading was kept at or below that of the steam reading. During the decoking period it was found that a small temperature rise occurred in all the tubes in the furnace rather than a ring of fire passing successively through each tube. A chart illustrating the decoking procedure is shown in Figure 2.

A crude furnace was used for the initial decoking experiment and at present plans are being made to increase the number of installations on other furnaces.

Removable Thermo-Wells and Protective Guards

The feed lines to the reactor of a fluid catalytic cracking unit contain oil vapors, steam and catalyst at a velocity of approximately 60 feet per second. As the catalyst particle size ranges anywhere from 0 to 80 microns, it is apparent that these conditions present a serious problem in maintaining thermocouple wells in these lines. A bare thermocouple well without a guard will last only three to four weeks. These thermocouples are the primary elements of the two temperature controllers by which the cracking reaction is controlled at approximately 900° F. The controllers position 30-inch slide control valves by throttling the flow of 1100° F. regenerated catalyst from the regenerator to the feed lines, and thus to the reactor.

In crude oil refining, the operating units until recent years were off stream quite frequently for clean-out, so the replacing of thermocouple wells and guards was just a matter of routine maintenance. Nowadays the cat crackers are setting new all-time records for length of runs; consequently, some means had to be found to keep thermocouple wells in lines of severe service during the long runs.

The thermocouple guards, which were originally of three-inch angle iron, were redesigned with the idea of breaking the catalyst flow as smoothly as possible, thus cutting down on the eroding effect. The point also had to be considered that if the guard was made too big the thermocouples would be pocketed in a dead space and thus would lose sensitivity to temperature changes. An iron wedge guard 10½ inches high, 2¼ inches wide and 8 inches long was installed with the knife edge facing the flow 1 inch upstream of the thermowell. This was found to outwear all designs tried. Tests on alloy coating of these wedge guards are underway at present.

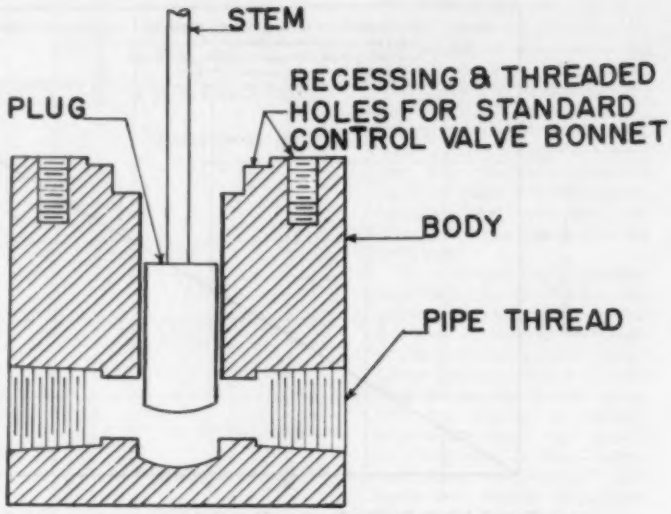


Figure 5. Specially Designed Control Valve for Use in Caustic Service.

The long duration of the cat cracker runs made the experiments very slow as it was sometimes well over a year before the results could be observed. Consequently, an additional means had to be employed to keep the thermocouples in these lines after the catalyst had eroded through both the guards and the well.

A removable thermocouple well assembly was devised, consisting of a 1½-inch collar welded to the line to which was screwed a special 1½x3-inch nipple, a 1½-inch gate valve with steam connection in both bonnet and bottom, a special 1½-inch barrel with 2-inch stuffing box on the outer end and a steam connection on the vessel side of the packing, a packing gland, and a special 25-inch ball and socket thermocouple well without taper. A ¾-inch cock was installed on the head end of the thermowell which could be closed if the well tip eroded away. The thermocouple well projected into the line 6 to 8 inches. Because the barrel assembly is longer than this it is possible to loosen the packing and pull out the well far enough to permit closing the 1½-inch gate valve before the eroded part of the well comes into contact with the packing.

This was found to be a very safe method of changing thermocouple wells during unit operation, as the reactor carries a pressure of only 15 psig, the packing is always in contact with the uneroded portion of the well, and snuffing steam is used at three points on the assembly.

Catalytic Cracking Unit Noise Reduction

The solution to the problem of reducing the noise level on our catalytic cracking units also tied in with the problem of automatically controlling the regenerator pressure. The excessive noise on the original installation was caused by high velocities due to a 6 psi pressure drop.

The 6 psi drop in the flue gas stacks was divided into 3 parts: 1) The original butterfly valve—2 psi drop; 2) The conventional orifice plate—1 psi drop; 3) The new Chapman slide valve —3 psi drop. These modifications reduce the velocity at each point with a corresponding decrease in noise level, and it is now possible to hold conversation at the base of the stack.

The new slide valve was manufactured with two slides on opposite sides of the body; one slide to be operated manually and the other to be operated automatically by a pressure controller.

Instead of operating the slide valves with one of several conventional hydraulic valve positioners with a piston as the motor, it was decided to try a reversible rotary air motor mounted directly to the handwheel shaft to be actuated by a conventional nul-balance control valve positioner that operates an air pilot valve controlling the 50-psi air supply to the air motor. This system has the advantage that it eliminates the fire hazard of the hydraulic fluid and the maintenance of a separate system because the air supply is already available where pneumatic control instruments are used.

We are able to justify installation on the basis that the regenerator could

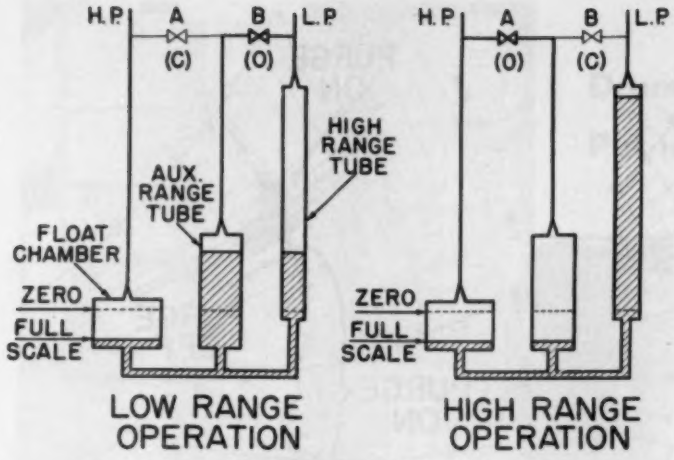


Figure 6. Dual Range Mercury Manometer Installation for Flow Measurement.

be run at ½-psi higher pressure if it could be automatically controlled. The ½-psi increase in pressure calculated a 2 percent increase in regenerator capacity due to decreased velocities at the higher pressure. Actually the installation has paid off on each of the two factors, noise level reduction and increased capacity.

Improvements in Regeneration Air Measurement

Calculations indicated that considerable air compressor capacity was being lost due to the orifice plate located in the suction line. Figure 3 shows the original installation. Each suction line was 30 inches in diameter and 30 feet long. A short section of the intake line supported the hood over the entrance and was 45 inches in diameter. Air flow to the compressor was measured by an orifice in the suction line about eight feet above the compressor inlet nozzle. An orifice with a .75 d/D ratio, flange taps and a meter range of 20 inches of water was used. This represented a sizeable pressure loss in air supplied to the compressor.

To reduce pressure loss in the suction line to the compressor, the modifications shown in Figure 4 were applied. The orifice was removed and the length of 45-inch pipe was increased, replacing the 30-inch pipe from the intake to the orifice flanges. The transition piece from the 45-inch to 30-inch section of the line was rolled at an angle of 15° with the vertical to form the entrance cone of a venturi. The remaining part of the line remained 30 inches in diameter, forming a "partial" venturi since there was no recovery cone. However, the lack of the recovery cone did not result in additional pressure loss since the venturi pressure drop appeared as an entrance loss in the original installation.

Pressure taps were installed above the entrance cone and in the throat below the entrance cone for measuring air intake, using a flow recorder with a range of 10 inches of water. The meter factor was calculated by using standard venturi flow calculations. A correction factor was determined after start-up from a test of all meters in the compressor discharge system.

As a result of the revisions to the compressor suction lines, the capacity of the compressors was increased by approximately 1½ percent with a decrease of approximately 1 percent in horsepower.

Expressed in terms of the original investment, the value of the change to the catalytic cracking units was approximately $110,000. The cost of the revisions was less than $1000 for the two compressors.

Controlling Flow of 50° Baume Caustic

One section of our treating plant contains a Unisol unit in which it is necessary to measure and control the flow of 50° Baume' caustic. This was found rather difficult with conventional instruments due to the tendency of the caustic to crystallize and due to materials that deposited out of the caustic.

The original installation consisted of a conventional mercury manometer type flow controller with a double-seated parabolic plug control valve. The maintenance of the mercury manometer seals was excessive and the control valve had a strong tendency to bridge over the ports with crystallized caustic and debris until the valve was wide open at which time a slow reduction in caustic rate occurred.

The mercury manometer was replaced by a D/P type cell mounted as close as possible to the orifice flange with no other supports than the meter piping. After steam tracing the installation we had no further trouble with the measurement problem.

Controlling, the second half of the problem, was solved by the design of a piston-type valve. The valve, shown in Figure 5, consists of a commonly used control valve diaphragm and yoke, and a newly designed valve body with a cylindrical plug. Tight shutoff is not essential. A somewhat balanced plug was obtained by cutting a slot on the downstream side of the plug. This equalized the pressures on the top and bottom of the plug. This valve is commonly called, by our instrument men, the "bone crusher."

Dual Range Mercury Manometer Flow Meters

The mercury differential type flow meter in its standard simple form with cylindrical mercury chambers and square root flow scale is limited in usefulness where there are wide changes in the rate of flow. The rangeability, or ratio of minimum-to-maximum practical flow readings is about 1 to 3½.

There are innumerable flow measurement and control applications where the maximum rates may be six or more times as great as the minimum flows. A few examples are seasonal changes in heating steam load; variations in feed and product rates on a refining process due to fluxuations in supply, demand, and composition; variations in solvent feed ratio requirements with changes in types of charging stock.

Numerous flow meter designs and arrangements are available for improvement on the rangeability of the conventional square root flow scale. Dual range meters of a somewhat novel design have been used successfully on several applications in our Lake Charles refinery. While no claim is made that it is a cure-all design, it does have certain advantages and may be found quite useful in other plants.

Figure 6 indicates the arrangement of the mercury chambers, U-tubes, and valve manifolds, and shows the mercury levels under various conditions.

The standard float chamber, shown at the left, is on the high-pressure or upstream side of the orifice. The auxiliary range tube is in the center and the so-called high range tube is at the right. In operation on low-range serv-

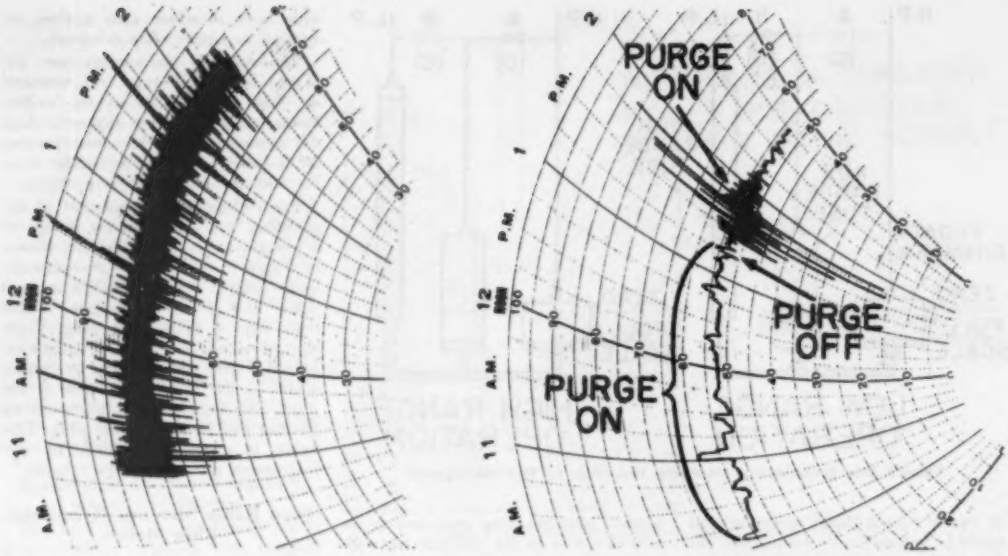


Figure 7. Improvement in Level Controllers Through Use of Purge Gas.

ice, valve *A* is closed and valve *B* is open to place the two range tubes in parallel, both on the low pressure or downstream side of the orifice; the mercury levels will rise simultaneously in these two tubes as the differential pressure increases. This arrangement gives the equivalent of one large-diameter range tube.

For high-range service valve *B* is closed and valve *A* is opened to place the auxiliary tube in parallel with the float chamber. With an increase in differential pressure the mercury levels fall simultaneously in the float and auxiliary chambers and rise only in the right hand or high-range tube. This gives the equivalent of a large-diameter float chamber and a relatively small-diameter range tube.

With this design it is possible to change from low to high range or vice versa by manipulating valves *A* and *B* without zero-ing the meter. On a sealed meter, however, it is particularly desirable first to equalize and zero the meter in the conventional manner. Otherwise, some loss of sealing liquid and unbalancing of the seals would take place after repeated range-changing.

Surging of Side Stream Level Controllers

A condition existed in our side stream strippers at the crude topping units and Fluid catalyst cracking Units which demanded attention.

The level measuring devices were, in all cases, displacement type leveltrols. At the crude topping units the level instruments were controlling the valves direct with the controlled air showing percentage of valve opening on indicating gauges in the control rooms. In some cases at the Fluid catalyst units the level instruments transmitted to instrument type recording controllers.

The condition under discussion was an erratic cycling of the level instruments and control valves. The pulsations varied in time from several per minute to one in three minutes, in intensity from one to five pounds change in the controlled air pressure. This condition was determined by connecting a portable pressure recorder into the output air lines between the level controllers and the valves.

An experiment was conducted to see if this condition could be corrected. A natural gas purge line was connected to the top of the float cage and gas was pressured thru a restriction orifice into the vapor space of the float cage. After a lapse of fifteen or twenty minutes, the surging stopped, as shown in Figure 7.

It was determined that light oil vapors and steam were condensing in the top of the float cage, forming drops of liquid and falling to the lower portion of the float cage where they hit the hot oil. They would flash-vaporize, causing a reaction similar to a miniature explosion, raising the pressure in the upper section of the float cage thus causing the oil to flow back into the stripper through the lower float conection. The instrument was then giving the true level within the float cage, but this level did not correspond with the level in the stripper.

Introducing the gas purge prevented the steam and light oil vapors from entering the float cage and thereby eliminated the trouble.

The benefits obtained by correcting this condition are as follows:

1.) The pulsating rate of oil flow to the stripper was causing a marked decrease in the efficiency of the stripper. When the oil flow rate in the stripper was high, the pressure drop through the stripper would increase, decreasing the amount of stripping steam flowing through the trays. In the opposite case, when the oil flow rate was decreased there would be an excessive amount of stripping steam flowing.

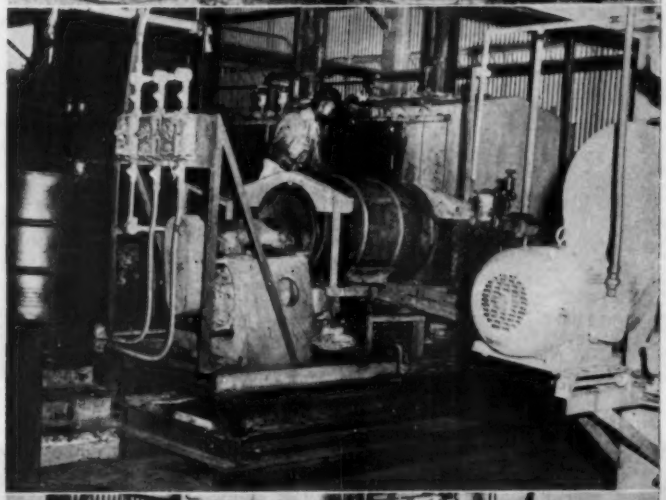
2.) Before installation of the gas purge systems, the rapid cycling of the level instruments and control valves was causing excessive wear, especially on the level controllers; therefore, maintenance costs were high. Since installation of the purge systems, maintenance cost, both material and labor, have been reduced to a minimum.

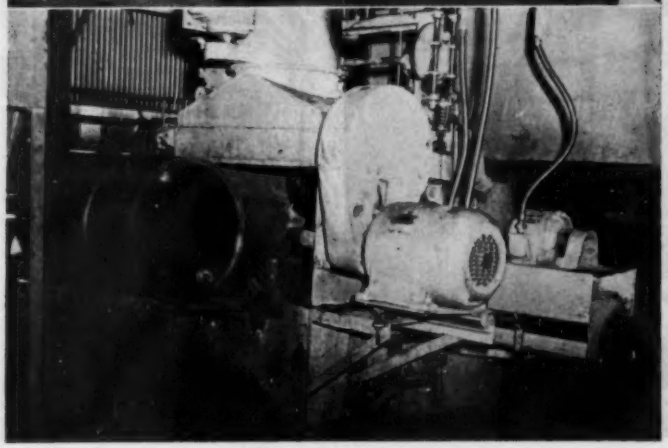
3.) Due to the varying drawoff rates from the main towers, the trays below the drawoff were functioning at reduced efficiency resulting in poorer fractionation.

Two other methods of combating this problem have been successfully used. These consist of steam-jacketing the float cage, and the use of a hot oil purge in the float cage.

Drum Reconditioning Put into Full Swing

Sinclair Foresees Shortage And Gets Busy on 700-Per-Day Program





SINCLAIR Refining Company's Houston refinery is not waiting for the anticipated barrel shortage to catch up with them. Recognizing the current shortage of raw materials eventually is going to handicap the refiner unless a good supply of barrels for finished products is available, Sinclair presently is reconditioning approximately 700 drums each eight-hour shift at its drum reconditioning plant.

As used drums are returned to the refinery they are carefully inspected, and if they meet requirements for reconditioning are conveyed first to a hydraulic dedenter. Next they are put through one of the six unit Portco cleaners going through five automatic operations. To begin the cleaning process, the drums are sprayed inside and out with a caustic solution, which removes paint, grease and dirt. Upon completion of this process, an automatic timer shuts down the wash pump and opens an air solenoid valve to siphon off the caustic solution. Then follows a fresh water

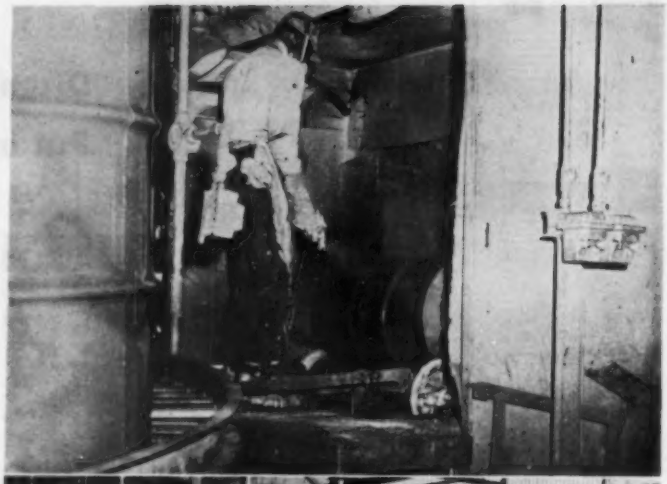
Top—Used drums, as they come to the reconditioning plant, are dirty, rusted, and usually dented. These drums are about to enter the reconditioning process.

Middle—After the used drums have been freed of dents by the hydraulic de-denter (out of camera range at the left), they are cleaned in washing booths, seen in background. Then they are inspected inside and out, and if satisfactory they are put on rails leading to the chine sealer and straightener, seen here.

Bottom—The drums are sent automatically from the chine straightener to the buffing machine, where revolving wire brushes clean off all remaining scale. They then roll out of the buffing machine into the painting booth, at right.

Top—As the drum is revolved on spinning rollers, the ends are sprayed with aluminum paint and the sides with the usual Sinclair green.

Center—When spraying is completed, the drum rolls onto a platform which automatically tips the drum up on end and onto a conveyor loading to the drying oven. The tilting platform in the photograph is returning to its starting position. The painter sprays the drum ends first with the spray gun in one hand and then the sides with the gun in the other hand.

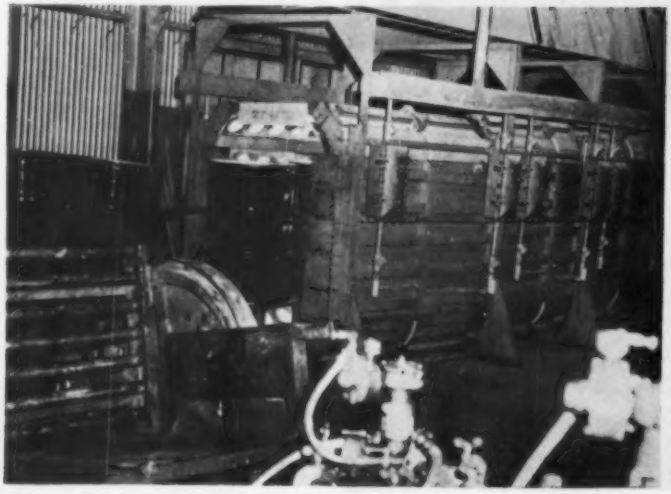


rinse and after the water is again siphoned off the drums are dried with blown hot air.

Next they are removed from the cleaners, inspected and conveyed to the automatic chime sealer and straightener. Next the drums move to an automatic buffing machine and then to the paint spray booth. Here the painter, "a two-gun man," sprays the drum ends first, with a gun held in one hand, and the sides with a gun in the other hand. Next they are automatically up-ended and conveyed through an infra-red drying oven; then to the stencil room, and then two reciprocating hoists with automatic feeds deliver the reconditioned drums to the barrel house for final inspection and distribution on conveyors to the proper filler.

Lower Left—The drums enter an infra-red lamp drying tunnel, where the fresh paint quickly dries.

Lower Right—The drums emerge from the tunnel dry, ready for final inspection and further service.



ORIFICE factors for flow calculations are of great convenience to process plant engineers. Available tables do not provide satisfactory factors for lines of heavy wall pipe. Factors calculated by AGA methods are presented here for the more frequently used heavy wall pipe sizes.

BASIC ORIFICE FACTORS
For Heavy Wall Pipe

J. B. ARANT

Instrument Engineer, E. I. du Pont de Nemours & Company, Inc.
Sabine River Works, Orange, Texas

THE only generally available table of basic orifice factors for orifice flow calculations consists of the American Gas Association Report No. 2 table covering 2-inch through 16-inch standard wall pipe. Other tables have been published covering selected sizes of heavier wall pipe, but in general these tables either are not available or contain basic mathematical errors which render them unsuitable.

In order to supplement the AGA Report No. 2 table and furnish reliable orifice factors for heavier wall pipe, the author has over a period of time calculated basic orifice data using as a basis the calculation methods obtained from the AGA Gas Measurement Committee Report No. 2 and Appendix. The calculations are for flange taps and cover factors for 14-inch standard wall pipe, 8-inch through 16-inch Schedule 40 pipe and 2-inch through 8-inch Schedule 80 pipe.

It is to be noted that Standard and Schedule 40 pipe correspond up to and including 6-inch, and Extra-Strong and Schedule 80 pipe correspond up to and including 8-inch. The basis for calculation is for a gas of specific gravity = 1.00, temperature measurement base = 520° F. absolute, pressure measurement base = 14.4 psia and flowing temperature = 520° F. absolute.

For those readers not familiar with the concept of the basic orifice factor a brief note of explanation will aid in clarification. The basic orifice factor is known as the F_b factor and is found in the following equation:

$$C' = F_b \times F_{tb} \times F_{pb} \times F_{tf} \times F_g \times F_{pv} \times F_r \times Y_2$$

where C' = orifice flow coefficient
F_b = basic orifice factor
F_{tb} = temperature base factor
F_{pb} = pressure base factor
F_{tf} = flowing temperature factor
F_g = specific gravity factor
F_{pv} = super-compressibility factor
F_r = Reynolds Number factor
Y_2 = expansion factor

Thus, one can see that the total flow coefficient, C', is composed of a basic orifice factor, F_b, modified by corrections necessary to fit the actual condition of measurement. This F_b factor is a function of the Beta ratio (or orifice diameter to pipe I.D. ratio) and the coefficient of discharge. Briefly, the development of the basic orifice factor calculation is as follows:

From the AGA Report No. 2, the basic orifice flow factor is defined by the equation

$$F_b = 218.44\, D_2^2\, K \frac{T_b}{P_b} \sqrt{\frac{1}{T_f G}}$$

where F_b = basic orifice factor
D_2 = orifice diameter in inches
K = coefficient of discharge
T_b = base temperature in °F. absolute
P_b = base pressure in psia.
T_f = flowing temperature in °F. absolute
G = specific gravity of flowing gas

Flange Taps—Fb

Orifice Size D_2	I.D. OF PIPE (Standard), D_1								
	2.067	3.068	4.026	6.065	8.071	10.136	12.090	13.250	15.250
0.250	13.002	12.996	12.974						
0.375	29.079	29.026	28.948						
0.500	51.690	51.444	51.376	51.328					
0.625	81.129	80.426	80.218	80.080					
0.750	117.77	116.16	115.67	115.30					
0.875	162.11	158.70	157.81	157.08	156.82				
1.000	215.04	208.21	206.62	205.45	204.97				
1.125	277.93	264.97	262.21	260.39	259.69	259.27			
1.250	353.04	329.41	324.72	321.93	320.94	320.35	320.00		
1.375	443.44	402.10	394.35	390.11	388.73	387.93	387.47	387.18	
1.500	554.71	483.80	471.35	464.98	463.10	462.07	461.44	461.12	
1.625		575.47	556.06	546.62	544.07	542.73	541.93	541.48	541.06
1.750		678.61	648.93	635.11	631.64	629.94	628.93	628.39	627.85
1.875		794.99	750.50	730.55	725.90	723.73	722.48	721.99	721.15
2.000		926.76	861.42	833.06	826.86	824.11	822.56	821.70	820.98
2.125		1076.6	982.50	942.93	934.50	931.10	929.21	928.39	927.36
2.250		1251.2	1114.9	1060.0	1049.1	1044.7	1042.4	1041.5	1040.1
2.375			1259.9	1184.9	1170.5	1165.1	1162.3	1161.2	1159.5
2.500			1419.0	1317.7	1299.0	1292.1	1288.7	1287.2	1285.4
2.625			1593.9	1458.7	1434.4	1425.8	1421.7	1420.0	1417.9
2.750			1786.7	1608.3	1577.1	1566.0	1561.0	1559.4	1557.0
2.875			2000.3	1767.0	1727.1	1713.8	1707.9	1705.4	1702.6
3.000			2245.3	1935.2	1884.6	1868.2	1861.0	1858.4	1854.9
3.125				2113.4	2049.7	2029.5	2020.9	2017.6	2013.7
3.250				2302.4	2222.7	2197.8	2187.6	2183.8	2179.2
3.375				2502.8	2403.7	2373.4	2361.1	2356.7	2351.3
3.500				2715.7	2593.1	2556.1	2541.5	2536.4	2530.1
3.625				2941.9	2791.1	2746.2	2728.9	2722.5	2715.6
3.750				3182.5	2998.0	2943.5	2923.2	2915.9	2907.9
3.875				3438.5	3214.2	3149.1	3124.6	3116.2	3106.8
4.000				3711.4	3439.9	3362.1	3333.1	3323.5	3312.5
4.250				4313.2	3922.0	3812.1	3772.0	3758.7	3744.6
4.500				5013.1	4448.7	4295.5	4240.5	4222.6	4203.8
4.750					5024.8	4812.8	4739.6	4715.9	4691.2
5.000					5656.2	5390.9	5270.4	5239.2	5206.7
5.250					6349.6	5965.5	5834.0	5793.2	5751.2
5.500					7112.9	6604.3	6432.1	6378.7	6324.8
5.750					7956.0	7289.8	7056.1	6997.5	6928.6
6.000					8906.5	8026.3	7738.1	7650.3	7563.0
6.250						8818.7	8450.0	8339.7	8229.2
6.500						9672.0	9204.9	9068.2	9027.8
6.750						10592	10006	9831.5	9660.4
7.000						11587	10856	10639	10428
7.250						12664	11759	11491	11231
7.500						13851	12719	12391	12073
7.750							13741	13340	12954
8.000							14830	14345	13877
8.250							15991	15406	14843
8.500							17231	16531	15856
8.750							18564	17723	16918
9.000							20014	18985	18031
9.250								20325	19198
9.500								21752	20426
9.750								23289	21715
10.000									23070
10.250									24496
10.500									25997
10.750									27578
11.000									29253
11.250									31042

Flange Taps—Fb

Orifice Size D_2	I.D. OF PIPE (SCH. 40), D_1				
	1.939	2.900	3.826	5.761	7.625
0.250	12.987	.....	.....	.....	.....
0.375	29.067	29.037	.....	.....	.....
0.500	51.716	51.686	51.391	.....	.....
0.625	81.319	80.518	80.261	80.115	.....
0.750	118.24	116.32	115.75	115.37	.....
0.875	162.16	158.96	157.94	157.16	156.86
1.000	317.26	208.73	206.85	205.55	205.04
1.125	382.39	265.92	262.56	260.56	259.80
1.250	361.48	331.06	325 32	322.15	321.03
1.375	458.84	404.90	395.30	390.41	388.99
1.500	.....	488.33	472.86	465.46	463.39
1.625	.....	582.74	558.42	547.27	544.46
1.750	.....	689.99	652.46	636.07	632.17
1.875	.....	812.19	755.71	731.82	726.59
2.000	.....	952.15	868.91	834.86	827.83
2.125	.....	1116.6	993.23	945.30	935.76
2.250	.....	.....	1130.0	1063.3	1050.7
2.375	.....	.....	1280.8	1189.3	1172.5
2.500	.....	.....	1447.5	1323.5	1301.5
2.625	.....	.....	1632.2	1466.4	1437.7
2.750	.....	.....	1838.4	1619.4	1581.2
2.875	.....	.....	.....	1779.6	1732.2
3.000	.....	.....	.....	1951.6	1891.0
3.125	.....	.....	.....	2134.3	2057.7
3.250	.....	.....	.....	2328.8	2232.6
3.375	.....	.....	.....	2536.0	2416.0
3.500	.....	.....	.....	2757.0	2608.2
3.625	.....	.....	.....	2993.0	2809.5
3.750	.....	.....	.....	3245.1	3020.2
3.875	.....	.....	.....	3515.0	3241.1
4.000	.....	.....	.....	3803.5	3472.3
4.250	.....	.....	.....	4455.2	3968.5
4.500	.....	.....	.....	.....	4513.9
4.750	.....	.....	.....	.....	5115.3
5.000	.....	.....	.....	.....	5779.7
5.250	.....	.....	.....	.....	6515.3
5.500	.....	.....	.....	.....	7335.9

Flange Taps—Fb

Orifice Size D_2	I.D. OF PIPE (SCH. 40), D_1				
	7.981	10.020	11.938	13.126	15.000
0.875	156.82	.....	.....	.....	.....
1.000	204.98	.....	.....	.....	.....
1.125	259.75	259.29	.....	.....	.....
1.250	320.97	320.38	320.15	.....	.....
1.375	388.80	388.04	387.48	387.23	.....
1.500	463.17	462.12	461.47	461.19	.....
1.625	544.14	542.78	542.06	541.62	541.06
1.750	631.80	629.97	629.04	628.46	627.99
1.875	725.99	723.78	722.55	721.87	721.28
2.000	827.06	824.39	822.70	821.79	820.94
2.125	934.93	931.33	929.28	928.30	927.47
2.250	1049.4	1044.8	1042.6	1041.6	1040.1
2.375	1170.9	1165.4	1162.4	1161.3	1159.5
2.500	1299.4	1292.4	1289.0	1287.4	1285.5
2.625	1435.0	1426.2	1422.2	1420.1	1418.0
2.750	1577.8	1566.8	1562.0	1559.5	1557.1
2.875	1728.0	1714.4	1708.3	1705.0	1703.1
3.000	1885.6	1868.7	1861.6	1858.4	1855.2
3.125	2051.2	2030.1	2021.4	2018.1	2013.9
3.250	2224.5	2198.6	2188.2	2184.1	2179.6
3.375	2405.9	2374.6	2361.7	2357.1	2351.7
3.500	2595.8	2557.5	2542.5	2536.8	2530.6
3.625	2794.2	2747.8	2730.0	2723.3	2716.4
3.750	3001.9	2945.6	2924.4	2916.7	2908.5
3.875	3218.8	3151.3	3125.9	3117.2	3107.8
4.000	3445.8	3364.5	3334.9	3324.4	3313.8
4.250	3930.2	3815.6	3774.5	3760.0	3745.8
4.500	4460.4	4300.3	4243.7	4224.3	4205.8
4.750	5040.7	4820.7	4743.7	4718.0	4693.9
5.000	5678.1	5378.9	5275.9	5241.8	5209.9
5.250	6378.6	5977.6	5840.6	5796.8	5754.7
5.500	7152.0	6619.9	6441.0	6383.7	6329.6
5.750	8009.6	7310.4	7078 0	7003.5	6934.9
6.000	.....	8053.2	7752.8	7658.2	7571.4
6.250	.....	8852.8	8469.2	8349.2	8239.3
6.500	.....	9715.5	9228.4	9077.9	8940.6
6.750	.....	10647	10035	9846.8	9675.7
7.000	.....	11655	10893	10658	10448
7.250	.....	12752	11804	11514	11253
7.500	.....	.....	12775	12419	12101
7.750	.....	.....	13810	13375	12989
8.000	.....	.....	14913	14386	13918
8.250	.....	.....	16090	15456	14894
8.500	.....	.....	17357	16591	15917
8.750	.....	.....	18715	17794	16989
9.000	.....	.....	.....	19068	18116
9.250	.....	.....	.....	20427	19300
9.500	.....	.....	.....	21875	20545
9.750	.....	.....	.....	23442	21854
10.000	.....	.....	.....	.....	23231
10.250	.....	.....	.....	.....	24693
10.500	.....	.....	.....	.....	26214
10.750	.....	.....	.....	.....	27834
11.000	.....	.....	.....	.....	29560
11.250	.....	.....	.....	.....	31413

By fixing the conditions such that

$T_b = T_f = 520°$ F. absolute

$P_b = 14.4$ psia.

$G = 1.00$

and letting K become fixed at a particular value, Ko, which is the coefficient of discharge for infinite Reynolds Number and which will be the minimum value for any particular orifice and pipe size, the equation reduces to

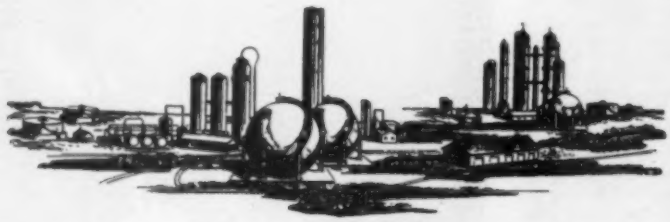
$$F_b = 345.92\ D_2^2\ Ko$$

Using this equation as a base, a value for Ko is calculated by the use of equations 17 through 25 of Appendix B, AGA Committee Report No. 2. These equations are rather complex empirical equations derived from experimental data and little will be served in this article by going into further detail.

It is hoped that the accompanying tables will serve a useful purpose in bringing together in one place, orifice factors covering a selection of widely used pipe sizes and weights. These tables have been given a good sample checking by various people in the gas measurement field with excellent agreement within the mathematically expected consistency of the calculations.

REFERENCE:

Gas Measurement Committee Report No. 2 & Appendix of the American Gas Association.



Atmospheric and Vacuum Units of Aramco's Refinery at Ras Tanura on the Persian Gulf Coast of Saudi Arabia. Built as a war project, the plant was designed in 1943 and rushed to completion in 1945 with about 1500 Americans and 10,000 Saudi Arab construction workers.

Aramco's Ras Tanura Refinery

DAVID ARNETT
Arabian American Oil Company, New York

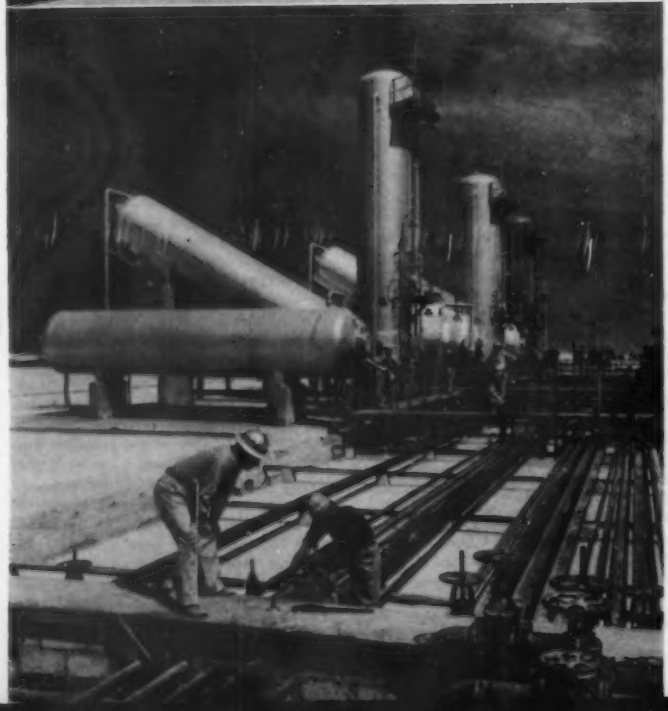
AT Ras Tanura on the Persian Gulf Coast of Saudi Arabia, Arabian American Oil Company operates a refinery, which has a charge rate of 160,000 barrels per calendar day. The refinery operations include atmospheric and vacuum distillation, thermal reforming, sweetening and asphalt processing to produce gasoline, kerosine, diesel oil, fuel oil and asphalt. Finished products are pumped a distance of seven miles to the marine terminal on the Persian Gulf for transshipment on ocean tankers.

Atmospheric and Vacuum Distillation Units

The refinery has two identical two-stage units for crude oil distillation. Four product streams are taken from the atmospheric column. The naphtha stream amounting to 24 percent of crude charge is taken overhead and heat exchanged with a portion of the crude charge. This naphtha overhead stream is taken to a conventional rerun column for separation of the light and heavy straight-run naphthas and the light straight-run naphtha is subsequently stabilized to the desired vapor pressure. The light straight-run naphtha is then pumped to the treating plant for sweetening while the heavy straight run is sent to the thermal reformers for processing. Approximately 8.5 percent of crude charge is taken as a kerosine side stream. This stream is stripped, cooled and pumped to the lead sulfide sweetening plant for treating. A light diesel oil side stream of 7.7 volume percent on crude is steam stripped, heat exchanged with crude feed, cooled and sent to tankage for blending. The major portion of the reduced crude from the atmospheric column is run to the vacuum column while roughly 4.5 percent on crude charge is taken to tankage for blending into fuel oils. Light waxy distillate overhead from the vacuum column amounting to around 18 percent of crude charge is heat exchanged with crude feed, cooled and sent to tankage for blending. A small side stream cut of heavy waxy distillate is taken for fuel blending. Roughly 35 percent of the total crude charged is taken as vacuum residuum from the vacuum column.

Refining Auxiliaries

Reformers: Essentially all heavy straight run naphtha is run to the thermal reformers of 22,500 BPCD capacity. The thermal reformers are run to improve the octane rating and increase vapor pressure of the heavy straight-run naphtha sufficiently so that gasoline specifications may be met in subsequent blends with light straight runs. Thermal reforming capacity has recently been increased to 22,500 BPCD by increasing the capacity of the reformer tubes in the radiant section of the reformer furnace. This capacity will soon be further increased to 23,500 BPCD by increased tube capacity in the soaking section of the reformer furnaces. The increased tube capacities have been made possible through use of improved alloy steel tubing which permits using a thinner-



Reformer Units

walled tube with greater internal volume for the same outside diameter tube.

Sweetening Plant: Five lead sulfide sweetening units are operated to sweeten all straight run, reformed naphthas and kerosines to a negative doctor test. Total capacity of these units is 60,000 BPCD.

Slop Dehydrator: This is an adjunct of the crude units with a capacity for slops of 1200 BPCD. About half of the running time for this unit is taken up on running slops and crude topping is carried on for the balance of time if the refinery is being run for maximum throughput. This unit can process 4000 BPCD of crude into straight run naphtha and topped crude. The straight run naphtha is separated into light and heavy straight run naphthas on the crude unit rerun columns and the topped crude is used as fuel oil cutter.

Fuel Oil Stripper: The fuel oil stripper is an auxiliary unit to the thermal reformers. This unit serves to strip naphtha from the fuel oil in the reformer bottoms product. In case of shutdown of this stripper unit its piping is tied into the slop dehydrator so that the reformers can continue to run utilizing the slop dehydrator for stripping bottoms product.

Furnaces: Maximum heat transfer capacity of each of the furnaces for the atmospheric towers originally was 69,300,000 Btu per hour. A convection section with a transfer capacity of 38,000,000 Btu per hour has been added to each of these furnaces giving a total transfer capacity of 107,300,000 Btu per hour. Approximately 12 percent of the crude is heated solely in the convection section of these furnaces. Each of the two vacuum furnaces were built for a maximum transfer capacity of 23,300,000 Btu per hour. Both the atmospheric and vacuum column furnaces are equipped with Peabody gas-oil burners.

Asphalt Plant: An asphalt plant is operated to produce asphalt for local use and for sale within Saudi Arabia to the Saudi Arab government and others. The plant is charged with 18-19 API gravity vacuum residuum and yields about 500 BPD of residual asphalt. The asphalt residuum is air blown to make a good grade of roofing and pipecoating asphalt and an asphalt base to which cutter stocks are added to make cutback asphalts for paving.

Sweetening Units

Supports for Vertical Pressure Vessels

PART III

F. E. WOLOSEWICK

Structural Engineer, Chicago

PRESSURE vessels in process plants are subjected to varied conditions of operating temperature and pressure. The operating temperatures may be anywhere from extreme low levels to the maximum that our construction materials will permit. Pressures may be high vacuum or several thousand pounds per square inch, or anywhere between. Vessels when placed in service or shut down commonly undergo large changes in temperature or pressure, or both. These changes induce stresses in the support structures through variations in expansion between support and vessel. Such stresses may on occasion be quite large.

Comparatively little information has been published on this subject, and it is thought that this study will be welcomed by those in the industry directly concerned with pressure vessel design, fabrication, inspection, and maintenance. This is the third of a four-part series. Part I appeared in July and Part II in the August issue of Petroleum Refiner.

Ring Stiffeners On Vessels

A SERIOUS objection to the use of continuous reinforcing is that rings introduce high longitudinal flexural stresses in the walls. The following explanation, although somewhat brief, will describe the behavior pattern of ring and shell.

A pressure vessel under the action of internal pressure tends to increase radially by an amount of $\frac{pR^2}{Et}(1-0.5v)$.

where p is the intensity of unit pressure, R mean radius of the vessel, t thickness of the wall, E modulus of elasticity, and v Poisson's ratio. This expansion is prevented by the ring, which tries to keep the shell at some other intermediate point. Bending stresses will be developed at the junction point of the shell and the ring.

For conditions of an infinitely stiff ring, a convenient mathematical boundary condition, a ring which does not yield, the maximum flexural stress is $1.82pR/t$,[9,10] on the inside in tension, and the same intensity in compression on the outside of the shell. To this must be added, the longitudinal stress due to internal pressure, which increases, the stress on the inside, and decreases those on the outside. The longitudinal stress from internal pressure is $0.5pR/t$, and hence, the maximum on the inside becomes $2.32pR/t$, and $1.32pR/t$ on the outside.

The above stresses are based on linear stress distribution through the thickness of the wall, which at elevated temperature, is undoubtedly modified into parabolic one. With increasing plasticity of metals, this parabolic stress distribution perhaps is still further modified into one approaching a more rectangular form. Hence the above stresses would be reduced somewhat at the outer boundary lines.

The probability of getting an infinitely stiff ring on the shell is quite rare, since such designs would automatically attract the attention of more practical engineers, who would introduce other methods for absorbing stresses. As reinforcing rings become more flexible, the above maximum values show a noticeable decrease, and for the more flexible rings approach values corresponding to those for internal pressures. In other words considerable "breathing" occurs in the reinforcing plates or rings.

Biot and Von Karman,[11] also Hetenyi[9,10] evaluated the approximate widths of the longitudinal run of the vessel which can be counted upon to be taken by the reinforcing ring. The effective width is approximately equal to $1.5\sqrt{Rt}$ where R is the mean radius of the vessel, and t thickness of the shell. Consequently the radial displacement of the ring can be evaluated approximately from the following equation:

$$w_R = \frac{1.5\sqrt{Rt}\,R^2}{EA_{ring}} \qquad (10)$$

Under internal pressure, the radial expansion of the vessel less the expansion due to ring would be approximately the net expansion which would cause bending in the shell. For conditions where rings are reasonably far apart, the following equation developed by Maulbetsch and Hetenyi,[10] taking displacements into account is shown below:

$$f = \frac{pR}{\left(\frac{0.55t + \frac{0.85?t}{A_{ring}}}{\sqrt{Rt}}\right)} \qquad (11)$$

where f is unit stress.

The reduction of stress due to flexibility of ring action is reasonably high as can be seen from Figure 17. It should be kept in mind that the theory is based on linear stress distributions which undoubtedly would not apply with high unit stresses at elevated temperatures of 900° or more.

Generally these stress intensifications factors are conveniently ignored in most of the smaller installations. In major types of pressure vessels some consideration must be given to the localized stresses, especially when smaller vessels are supported from larger ones.

When reinforcing rings are used to assist the shell in carrying flexural stresses by ring action, it is considered good practice to utilize portion of the shell in conjunction with the ring. The effective widths have been evaluated by several investigators.

Von Karman[12] recommends that the total effective width should not exceed a value of $1.08\sqrt{Rt}$, centered on the the stiffening ring. The Department of Interior studies,[8] summarized in "Penstock Analysis and Stiffener Design" recommend the use of $0.78\sqrt{Rt}$ on each side of the stiffening ring. Several practical rules devised by number of engineers, have limiting values from 6 inches of the vessel wall to as

much as 16 to 30 times the thickness.

Stiffener ring can consist of bars either welded flat against the vessel wall, or perpendicular to it. Bars welded with the wide side to the shell are not as efficient structurally as the ones welded at right angles to the shell.

For moderate loads, "T's" are frequently used while for heavier concentrations, portions of "WF" sections will be found to be very effective.

Because of temperature differences between the inside and the outside of such rings, the perpendicular projections of the reinforcings rings should be kept at a minimum. The ideal location for such rings should be on the inside of the pressure vessels, but the constriction of the effective area may considerably offset process calculations. If such rings are placed externally, considerable attention should be given to thorough insulation, in order to minimize stresses due to temperature differences.

Skirt Supports

The more conventional way of supporting thin-wall pressure vessels, is by means of skirts welded directly to the vessel. The direct load is uniformly distributed over the gross area, while stresses due to pipe thrust and wind moments are determined in the same manner as stresses in columns due to combined action of direct load and flexure.

The conventional column equation under the action of bending moments in simplified form is presented below:

$$f = \frac{Q}{37.7Dt} \pm \frac{15.3M}{D^2t} \qquad (12)$$

where the positive sign applies to the leeward side, the negative values apply to the windward side.
D is the mean diameter of the skirt in feet.
t is the thickness of the skirt in inches.
f is the unit stress express in psi.
Q total gravity load in pounds.
M bending moment in foot pounds.
The various numerical quantities are simplified multipliers of section modulus and areas.

Frequently, the internal diameter of the vessel is used as the more convenient value than the mean diameter.

Thickness of the supporting skirt should be kept to a minimum consistent with structural stability and stress requirements at the operating temperatures. The practice of making supporting skirts of the same thickness as the walls of pressure vessels represents waste in materials. The thinner the skirt, the better it is able to adjust itself to temperature variations, and to angular deviations at the tangent line.

Various fabricators and steel erectors have evaluated reasonably safe working rules for permissible stress intensities on circular skirts, which are representative of sound practice. These stresses should be modified by governing temperature conditions, which vary with operating temperatures of the vessel in service.

The critical line in all such constructions is the weld joining the pressure vessel to the skirt. This weld in addition to transmitting direct load and wind forces must also resist flexural stresses due to temperature drop in the skirt.

Of the two methods of attaching the skirt to the vessel, the one in which the center line of the vessel wall is approximately coincident with the center line of the skirt wall appears to be the preferred one. Should failure occur in the weld, and such failures have happened in the past under normal operating conditions for that type of service, there is considerable assurance that the vessel will be stable, since ample area is provided in bearing due to shock loadings. With the method of attaching the skirt on the outside of the vessel, any weld failure through the throat of the weld, simply minimizes effective bearing area.

It may be said in passing, that when failures occur at the weld, due to thermal differences, the stress condition is better after failure, than it existed before, providing that ample stability is present against overturning.

Method of Absorbing Expansions

Vessels of large diameter and operated at elevated temperatures have considerable radial expansions. These expansions have been absorbed at times by providing continuous supporting rings, one on the supporting skirt, the other on the vessel, with provisions for sliding. To minimize frictional forces lubricated bronze plates have been used. Generally overturning moments are not serious, and no special provisions need be made for that condition.

In order to direct specific directioned expansion, guided holes or directional brackets have been used. Such construction provides greater assurance of directional expansions, and minimizes secondary displacements on major ducts or other connecting piping.

The supporting skirts are insulated on both sides to decrease differential expansions between vessel and skirt. The design of the supporting rings is not a difficult structural problem, and by providing a reasonable amount of brackets considerable stiffness can be attained in the supporting rings.

This type of construction may be somewhat awkward to assemble in the field to the correct level. However it is one of the best and simplest method known for absorbing displacements of large amounts without severe overstress to the vessel and the skirt. Another important factor in its favor is that creep, present at elevated temperatures, is not seriously constrained in such designs.

The more common practice however is to weld the skirt to the vessel, thoroughly insulate both sides, to maintain as small amount of temperature difference as possible, and to take any stresses which might arise in flexure of the skirt and the weld.

Temperature Drop In Skirts

Temperature variations in vertical skirts, insulated externally, internally or both, have apparently not been published. Surveys of literature in the past number of years does not disclose any detailed studies.

Recently some unpublished experimental data, on temperature variations have come to the writer's attention. Based on the above test data, the following empirical equation was evaluated by means of calculus of finite differences:

$$T_x = (T_v - 50°) - 6.037x - 0.289x^2 + 0.009x^3 - 0.00007x^4 \qquad (13)$$

where T_x is the metal temperature at a distance x below the tangent line. x is expressed in inches.
T_v is the temperature of the vapor or vapor or liquid. x distance in inches from the tangent line, parallel to the longitudinal direction of the vessel, towards the foundation.
In the above equation both surfaces of the skirt were insulated with equal amounts of insulation. Total insulation varied from 2 to 4½ inches.

The above equation does not satisfy fully the experimental data, but it does give fairly reasonably average values. The experimental data in some cases indicated approximately linear temperature variations, while in others, those in the higher temperature ranges, the variation appeared a parabolic one.

At higher temperatures, above 500° the temperature gradient was about 9° per inch of height, while for lower temperatures this variation was more pronounced.

When the liquid temperature in the vessel was above 400° F., the temperature at the bottom of the skirt was approximately 200°. This was quite consistent for short and long skirts. When the liquid temperature was about 300°, the temperature at the bottom of the skirt, of 50 inches in height, insulated with two inches on both sides, was slightly over 100°.

Assuming the temperature at the bottom of this skirt at or about 200°,

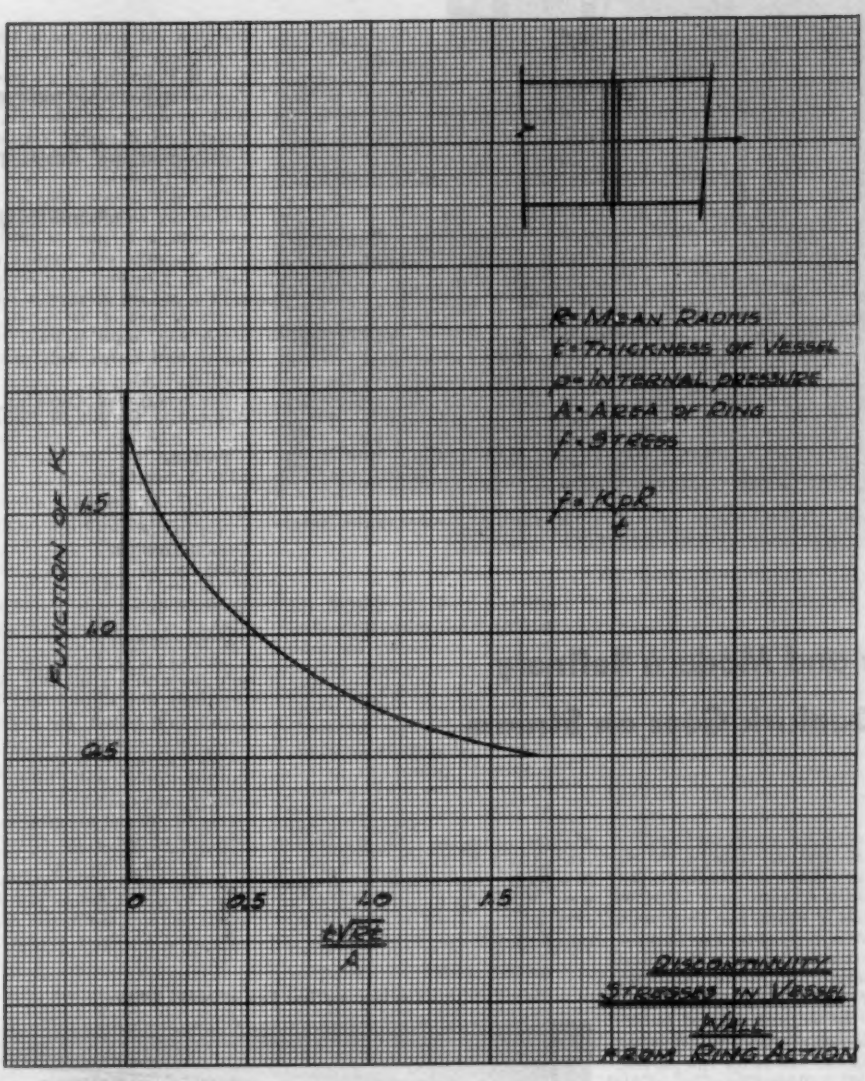


Figure 17

based on experimental tests, the diametral expansion should be in order of 0.01 inches per diametral foot of vessel. Hence for a ten foot vessel, the radial expansion would be about 0.05 inches, or roughly about 1/16 inch.

A survey of some vessels operating at much higher temperatures with shorter skirts, should indicate temperatures at the bottom of the skirt to be of slightly higher order. The obvious conclusion would be that radial expansions consistent with temperatures would be indicated, and that the bottom of skirts would expand radially.

Field observations of some installations in the past, did not indicate any perceptible radial expansions of the bottom of the skirts. The conclusions which might be drawn is that the skirts were frozen to the foundation. Since temperatures are present at the bottom, compressive stresses would be developed in the lowest parts of these skirts.

These stresses due to restraint of the base are apparently not serious, and since they are of compressive nature, are stabilized and constrained by vertical loads, offer considerable stability to the bottom of the skirt.

End of Part III. Part IV will appear in an early issue.

NOTE—The author, Mr. Wolosewick, is connected with Sargent and Lundy, Engineers, Chicago.

REFERENCES

[8] Hetenyi, Miklos, "Beams on Elastic Foundations," University of Michigan Press.
[9] Penstock, "Analyses and Stiffner Design," Department of Interior.
[9] Coates, W. M., "State of Stress in Full Heads of Pressure Vessels," Trans. American Society of Mechanical Engineers, Vol. 52, p. 117, 1930.
[10] Multesch and Hetenyi, "Stresses in Pressure Vessels," American Society of Mechanical Engineers, Vol. 3, No. 3, p. A107, 1934.
[11] Karman and Biot, "Mathematical Methods of Engineering."
[12] Roark, "Formulas for Stress and Strain."

Dunkirk Refinery in France. Left to right are the topping unit, the deasphalting plant and the reforming unit.

New and Modern Refinery At Dunkirk Goes on Stream

THE rebuilt and greatly expanded Societe Generale des Huiles de Petrole refinery at Dunkirk, an integrated unit with a nominal crude input of 28,700 barrels daily of Middle East crude, went on stream in September. The Lummus Company erected the atmospheric vacuum distillation unit, solvent redistillation unit, copper chloride treatment unit and plant for the preparation of emulsifiable road asphalts, cutbacks and industrial asphalt as well as the lube oil unit. The M. W. Kellogg Company was responsible for the naphtha reforming plant, while S. G. H. P. engineers designed and built facilities for the separation and treatment of butane and propane, caustic soda and chemical treatment of light solvents and kerosine, bitumen barreling, wax treatment and packaging and disposal of waste products.

In the summer of 1948 it was decided to build all the producing units at Dunkirk rather than split them between this location and Courchelettes, some 70 miles to the south inland. The enlarged main site of 180 acres was devoted to the process plant, intermediate tankage, maintenance and utilities and oil dispatching; the larger of the new plots of 68 acres houses the crude and finished product tank farms. The third plot of 20 acres is reserved for future development. Work was started in November, 1948, and the topping unit was commissioned the following February. The entire plant was completed in September. Courchelette will still be of value to S. G. H. P. through its workshops, as a distributing center for LPG, white and black products and lube oils, and to manufacture, if needed, certain special items outside the normal production range of Dunkirk.

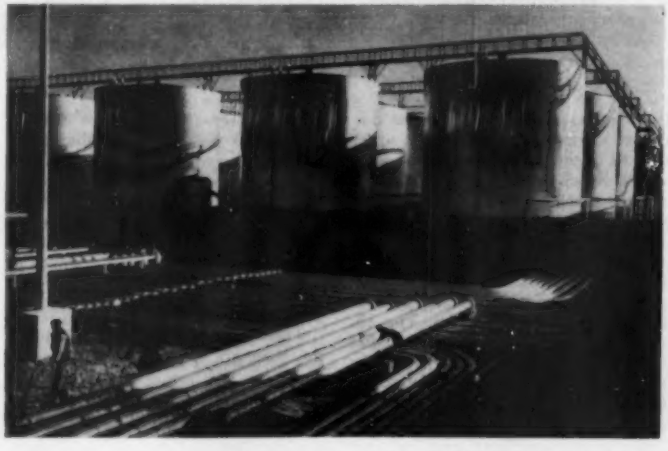
The main process units of the new refinery are an atmospheric distillation unit with a thruput of 8800 barrels daily; a caustic soda treating plant for gasoline; a doctor treater for gasoline; a TEL unit for gasoline; a solvent redistillation unit of 200 barrels daily; a double unit copper treatment of gasoline of 6000 barrels daily and an acid plant.

The modernized Dunkirk refinery manufactures the following products:

Products	Barrels Daily
LPG (C_3 and C_4)	570
Gasolines	7440
Kerosines and solvents	260
Motor gas oil	2600
Domestic fuel oil	1683
Light fuel oil	1800
Heavy fuel (1 and 2)	6623
Lubricating oil	1070
Wax	262
Various bitumens	2093

Utilities are provided from high pressure steam boilers and pass out-turbo-generators with a small input from the French Grid system. The cooling water plant consists of motor driven vertical pumps drawing suction directly from the Dunkirk harbor turning basin. The new refinery enjoys excellent dispatching facilities by rail and navigable canal. The jetty constructed in the harbor turning basin permits simultaneous reception of two super-tankers. The refinery is connected by four eight-inch pipe lines over a mile long to a distribution depot serving several petroleum companies.

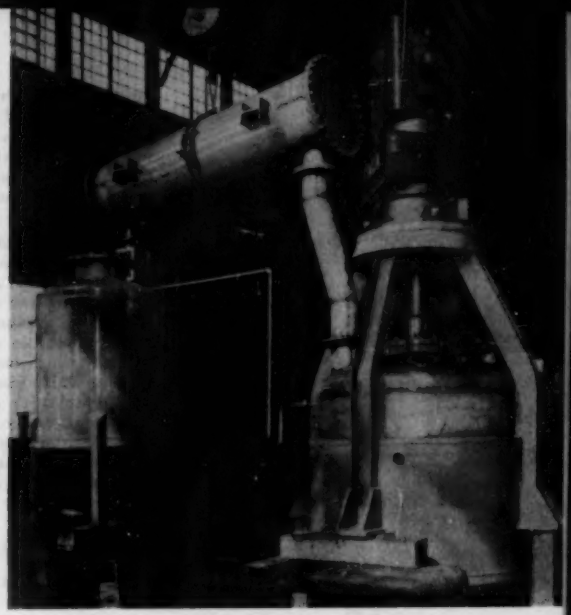
Pipe Lines and Tank Farm of Dunkirk Refinery.



Introduction to Chemical Reaction Calculations

Part II. Reaction Kinetics

A. M. PLATT
General Electric Company, Hanford, Wash.
and
G. L. FARRAR
Associate Professor of Chemical Engineering
The Agricultural and Mechanical College of Texas, College Station



Five Hundred-Gallon Stainless Steel Resin Kettle, Condenser, and Receiver. (Courtesy of Blaw-Knox Construction Company.)

PART I in this series outlined the importance of a knowledge of equilibrium yields in any chemical process. Such knowledge permits rough economic calculations on the feasibility of any particular process and is often the deciding factor concerning further development work. Unfortunately, however, equilibrium calculations do not indicate either the rate at which a reaction will proceed or the residence time needed. These data are extremely necessary because they directly influence the size of the reactor equipment that will be needed. Consequently, they often prove economically and process wise to be a more decisive factor than ultimate equilibrium yields. Calculations involving rates and residence time are properly tabulated under the term, kinetics.

In the study of chemical kinetics it is also necessary to evaluate the influences of variables such as pressure, temperature, concentrations, and catalysts on reaction rates and yields. Guldberg and Waage (1864-1867), after investigation of dynamic chemical equilibria, postulated that the rate of a chemical reaction is proportional to the active masses of the reacting substances. This postulation was proved to be valid and termed the "Law of Mass Action." The active masses were defined as the concentrations of the reactants and products raised to a power given by the numerical coefficient of the substance in the stoichiometric reaction equation. For the reaction,

$$aA + bB \rightleftarrows cC + dD,$$

AS NOTED IN Part I of this three-part series, the specifications of petroleum products are becoming more exacting and the variety of products much wider. The subjects of chemical equilibrium and chemical engineering kinetics are of increasing interest to refiners. This section of the series is concerned with reaction kinetics.

Chemical reactions may be of first, second, or higher order, depending on the number of reactants and the way in which they react with other. Determination of this order is necessary to make calculations concerning reactor size, residence time, and other pertinent factors. Once the order is determined, the procedure is given for making calculations and in a given problem this calculation procedure is indicated.

the forward and reverse velocities may be expressed as follows:

$r_f = k_f (C_A)^a (C_B)^b$, for forward reaction
$r_r = k_r (C_C)^c (C_D)^d$, for reverse reaction
C_A is concentration of A, mols A per unit volume.

The Law of Mass Action shows that the rate of reaction must be exponential in character, decreasing as time lapses and the concentration of active material disappears through the reaction. This effect is shown qualitatively in Figure 5.

It may be noted that, depending on the reaction, the number of active masses to be considered may vary. The number of molecules entering into a chemical reaction is called the molecularity of that reaction. In the example taken above the molecularity of the forward reaction is two when $a = b = 1$, and that of the reverse reaction is also two when $c = d = 1$. If the reaction actually proceeds according to its stoichiometry, the so-called "order" of the reaction is equal to the molecularity. However, if the mechanism of the reaction is different from the molecularity, the order will be different. For example it is sometimes possible to deal with a reaction in which there are two reactants in the same manner as is used to deal with a reaction in which there is only one reactant. Such phenomena can not be predicted in advance; such information must be determined experimentally. As may be seen, the order of the reaction, which depends on the actual reaction path, is the important consideration in a kinetic study. From the standpoint of this presentation, only such examples will be taken in which order is equal to molecularity.

From the foregoing, it is seen that when rate of reaction is proportional only to the active mass of one molecule, the process is termed first order:

$r = k C_A$, where the terms are defined as before.

The reaction rate, r, is also defined as the rate of disappearance of component, A, per unit time per unit reactor volume, or,

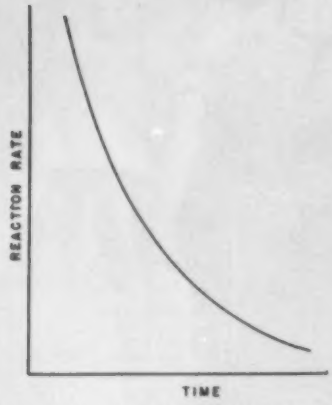


Figure 5. Variation of Reaction Rate with Time.

$$r = -\frac{dA}{V\,d\theta}$$. Thus,

$$r = -\frac{dA}{V\,d\theta} = k\,C_A \qquad (18)$$

The decomposition of nitrogen pentoxide is a first order reaction,

$$N_2O_5 \rightarrow 2NO_2 + \tfrac{1}{2}\,O_2$$

The inversion of cane sugar proceeds according to the following equation when free acid is present,

$$C_{12}H_{22}O_{11} + H_2O \rightarrow C_6H_{12}O_6 + C_6H_{12}O_6$$

This reaction is actually of first order, involving two active materials. Water takes part in this reaction but is present in such large amounts that its concentration does not change appreciably as the reaction proceeds. Experimental data also show that the correct kinetic equation is first order.

A second order reaction is by definition one the rate of which is a function of two concentration terms:

$$r = -\frac{dA}{V\,d\theta} = k\,C_A\,C_B \qquad (19)$$

Similarly, if there are only two type molecules involved, the reaction is termed bimolecular:

$$A + B \rightarrow \text{Products.}$$

Third or higher order reactions are quite uncommon, only a few confirmed reactions being known. Such reactions would involve the simultaneous collision of three or more different type molecules, and this phenomenon is quite rare. Reactions of fifth order have been shown, but the investigators are uncertain about their interpretation of the data.

The reactions discussed thus far have been irreversible reactions; that is, there is no appreciable reaction of the products to reactants. Thus, summarizing the above, it may be said that the kinetics of an irreversible reaction may be specified by molecularity (number of types of molecules reacting) or by order (the number of active masses that determine the rate). These two terms are usually equal in magnitude.

Before investigating the use of the differential equations presented thus far, it is deemed advisable to investigate the nature of the active mass terms and reaction velocity constants which appear in every equation. The quantity which most nearly represents the true active mass has been found to be the activity of the substance in question, rather than the concentration, as originally thought. With certain qualifying assumptions the term activity may be resolved into more easily measurable or calculable quantities.

If the materials are gases,

$$a = f/f^\circ = \delta\pi_Y/f^\circ = \delta p/f^\circ = \delta\pi N/f^\circ N_T = \delta\pi CV/f^\circ N_T, \qquad (20)$$

and the standard state conditions may be selected so that $f^\circ = 1$ atmos. In the above equations, N refers to the number of mols of a given component, while N_T refers to the total number of mols present in a mixture. Other terms are used as previously defined. Using these equations, the velocity may be expressed in six ways. For the reaction,

$$A + B + N' \rightarrow \text{Products,}$$

$$-dN_A/Vd\theta = k_a\,a_A\,a_B - a_N' \qquad (21)$$

$$-dN_A/Vd\theta = k_f\,f_A\,f_B - f_N' \qquad (22)$$

$$-dN_A/Vd\theta = k_p\,y_A\,y_B - y_N' \qquad (23)$$

$$-dN_A/Vd\theta = k_p\,p_A\,p_B - p_N' \qquad (24)$$

$$-dN_A/Vd\theta = k_N\,N_A\,N_B - N_N' \qquad (25)$$

$$-dN_A/Vd\theta = k_c\,C_A\,C_B - C_N' \qquad (26)$$

Note that N_A is here used as A has also been used before; that is, as number of mols of component A. Too, N_A/V may be recognized as concentration of component A.

The rate of reaction must be independent of the system of measurement, thus indicating the relationships that exist between the various values of the specific reaction constants. For example,

$$k_a = (k_f\,f_A\,f_B\,f_C - f_N)/(a_A\,a_B\,a_C - a_N) = k_f\,f^\circ_A\,f^\circ_B\,f^\circ_C - f^\circ_N$$

$$\text{Or, } k_a = k_f \qquad (27)$$

If the materials are liquids, or if a heteregeneous reaction is involved, the activity or fugacity terms have to be retained as active masses.

The specific reaction constant, k, may be evaluated by determining the instantaneous reaction velocity and active masses at some instant or by means of integrated equations to be developed later in this article. Various investigators have proposed means of calculating the reaction constant and

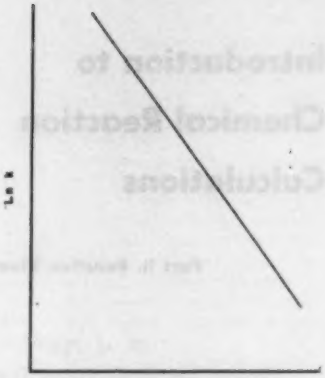


Figure 6. Variation of Reaction Rate Constant with 1/T.

discussed the theoretical factors causing the change in k with temperature.

Increasing the reaction temperature almost invariably increases the velocity of a homogeneous chemical reaction. The specific reaction constant is usually doubled or trebled with an increase of 10° C. in temperature. The equations developed by Arrhenius are usually employed to show this behavior:

$$d\ln k/dT = E/RT^2 \qquad (28)$$

$$\ln (k_2/k_1) = E/R\,(1/T_1 - 1/T_2) \qquad (29)$$

$$\text{or, } k = Ae^{-E/RT} \qquad (30)$$

The integrated equations are applicable to almost all type processes, excluding chain reactions. To explain this equation Arrhenius suggested that every system contained normal and activated molecules. Molecules were considered activated when the contained energy per mol was equal to or in excess of an arbitrary level, E. It was assumed that only active molecules could take part in a reaction. The quantity, A, is called the frequency factor and represents the total frequency of encounters between reactant molecules. Later investigators proved the validity of his assumptions by the development of the collision theory of reactions.

The energy of activation may be found by plotting experimentally determined data as shown in Figure 6. The slope of this line is $-E/R$. With the thought in mind that E is an energy level, it is interesting to examine the reasons why a reaction velocity increases so rapidly with temperature. Maxwell (1860) developed the mathematical methods which are now used for probability calculations whenever large numbers of items are under consideration. His work produced the data

for Figure 7. In non-mathematical terms, this figure indicates the percentage of molecules having a certain velocity as a function of that velocity. The area under the curve is equal to the total number of molecules present. Increasing the temperature from T_L to T_H does not alter the general shape of the curve, but increases the velocity of the number of molecules represented by the shaded area. Remembering that kinetic energy is a function of the square of the velocity, a large increase in the number of molecules having energies equal to or in excess of E is occasioned by a small increase in temperature. This effect accounts for the fact that reaction velocities double or treble with a 10° C. temperature rise.

The collision theory fails in numerous cases to predict accurately specific reaction constants, notably when the reaction encompasses a chain reaction, or a "slow" reaction. Data on one of the better known "slow" reactions, the polymerization of 1:3 butadiene, indicates that a reaction occurs only in one of 10,000 activated collisions. To account for this phenomenon, Equation 30 is rearranged to contain a probability or steric factor, P:

$$k = P A e^{-E/RT} \qquad (31)$$

Values of the steric factor vary from 10^6 to 10^{-6}.

Another well-known theory of reactions is the Eyring theory of absolute reaction rates. It is more complicated than the collision theory, the development being based on the quantum theory and statistical mechanics, and is only mentioned here for the benefit of the more theoretical readers who would care to further peruse the subject. This theory permits a more accurate prediction of specific reaction constants, but again errors of a factor of 10 to 100 are well known. For additional information concerning this theory, a pertinent source is, "The Theory of Rate Processes," by Glasstone, Laidler, and Eyring, McGraw-Hill Book Company, New York (1941).

From an engineering viewpoint, the safest and most reliable method of obtaining reaction constants is from actual experimental data. For an extremely complicated process, involving reversible, side, and consecutive reactions, this task is stupendous. And unless a select few of the reactions predominate the picture, the engineer would do well to resort to the conventional development procedure of empirical correlation of reaction variables.

Experimental determination of reaction constants may be made by a number of different methods. Knowledge of the reaction mechanism is very helpful, but not necessary. In order to effectively illustrate and describe these methods it will be necessary to classify the most probable reaction types to be encountered and to consider each type separately. The arbitrary classification adopted by the writers is outlined below:

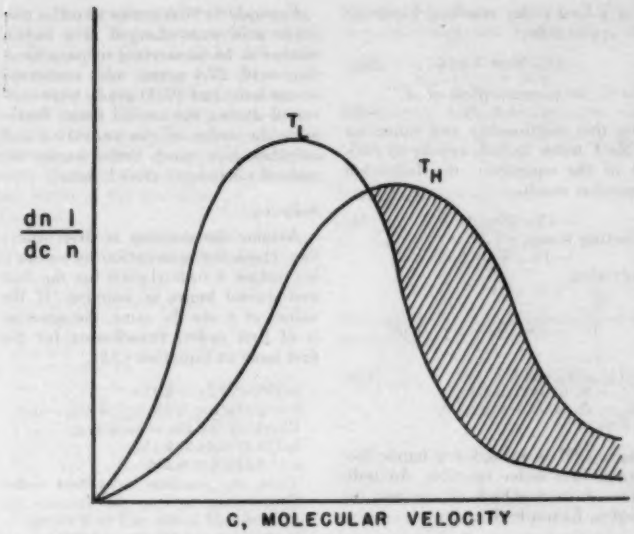


Figure 7. Maxwell's Distribution Curve.

I. Irreversible reactions
(Reactants → Products)
  A. Constant temperature and volume
    1. First order
    2. Second order
    3. Third and higher orders
  B. Constant temperature and pressure
    1. First order
    2. Second order
    3. Third and higher orders

II. Reversible reactions
(Reactants ⇄ Products)
  A. Constant temperature and volume
    1. First order forward; first order reverse
    2. Second order forward; first order reverse
    3. First order forward; second order reverse
    4. Second order forward; second order reverse
    5. Higher orders
  B. Constant temperature and pressure
    1. First order forward; first order reverse
    2. Second order forward; first order reverse
    3. First order forward; second order reverse
    4. Second order forward; second order reverse
    5. Higher orders

III. Side or Concurrent Reactions
(Reactants ⇄ Products (A —)
↘
Products (R —)
  A. Constant temperature and volume
  B. Constant temperature and pressure

IV. Consecutive Reactions
Reactants ⇄ Products (A—)⇄ Products (R —)

V. Non-isothermal Reactions

VI. Catalytic Reactions

It will be noted that the fundamental nature of side or consecutive reactions permit numerous possibilities to exist; i.e., first order forward and second order reverse for reaction A, plus second order forward and third order reverse for reaction B, etc. For this reason it does not seem advisable to attempt to tabulate all possibilities. As will be shown in later discussion, non-isothermal and catalytic reactions will be handled by the same techniques developed for Class I-IV reactions, thus making a detailed outline unnecessary.

Those who have had occasion to thoroughly pursue the subject of kinetics in the various texts are probably aware that a standardized nomenclature and method of presentation are non-existent. Nomenclature is not a serious obstacle, if adequate space is devoted to a description of the symbols employed. The adequacy of the method of presentation is usually dependent on the form of the experimental data available. In some cases equations referring to the amount of material which has disappeared are readily applicable. In other cases, equations indicating the exact amount of reactants remaining are most applicable. Equations of both types will be presented here.

For a first order reaction, Equation 26 is applicable:

$$-dN_A/V d\Theta = k_c C_A \qquad (26a)$$

Since C_A is concentration of A,

$$C_A = N_A/V \qquad (32)$$

Using this relationship and canceling out the V terms (which appear on each side of the equation), the following expression results:

$$-dN_A/d\Theta = k_c N_A \qquad (33)$$

Collecting terms,

$$-dN_A/N_A = k\, d\Theta$$

Integrating,

$$\int_{N_{A_o}}^{N_{Af}} -dN_A/N_A = \int_{0}^{\Theta} k\, d\Theta$$

$$\ln (N_{Af}/N_{A_o}) = k\Theta \qquad (34)$$

N_{Af} = lb. mols A at time 0.
N_{A_o} = lb. mols A at time Θ.
$k \equiv k_c$

Equation 34 is valid for a batch, isothermal first order reaction. An indication of its method of use may be found in Example 8:

Example 8: A chemical compound is being decomposed in a bomb. It is known that the reaction is of the type, A → Products. It is found that one-half of A is decomposed is twenty minutes. How much time is required to decompose 90 per cent?

Solution:

It is first necessary to calculate a value for k, using the information about the known decomposition.

$\ln (N_{Af}/N_{A_o}) = k\Theta$
In this case, $N_{Af}/N_{A_o} = 2/1 = 2$
Thus, $\ln (2) = k (20)$
Or, $k = 0.693/(20) = 0.03456\ min^{-1}$
Substituting this value of k and a value of $N_{Af}/N_{A_o} = 10$ into Equation 34,
$\ln (10) = 0.03465\ \Theta$
$\Theta = 2.303/0.03465 = 66.5$ min.

Example 9: 98.6 grams of ortho nicotinic acid were charged to a batch reactor to be isomerized to para nicotinic acid. 27.4 grams were converted in one hour and 19.80 grams were converted during the second hour. Determine the order of the reaction and calculate how much ortho isomer remained unchanged after 8 hours.

Solution:

Assume the reaction is first order; then check the assumption by comparing values k calculated for the first and second hours of reaction. If the values of k are the same, the reaction is of first order. Substituting for the first hour in Equation (34).

$\ln (98.6/71.2) = k\ (1)$
$k = 0.326/1 = 0.326\ hr^{-1}$, if first order
Checking for the second hour,
$\ln (71.2/51.4) = k\ (1)$
$k = 0.326/1 = 0.326.$
Thus, the reaction is of first order. Substituting to find the amount undecomposed at the end of 8 hours,
$\ln (98.6/x) = 0.326\ (8) = 2.605$
$98.6/x = 13.5$
$x = 7.3$ grams ortho isomer unconverted after 8 hours.

A word concerning the units of k as used in Equation (34) is in order at this point. Inspection of the left hand side of the equation shows that this quantity is dimensionless, since it is a ratio of two terms having the same dimensions. Therefore, the dimensions of the right hand side of the equation must also be dimensionless. The dimensions of Θ are time units, either seconds, minutes, hours, days, etc., depending on the time involved in the reaction. The units of k, then, must be reciprocal time units, 1/(time), with time being expressed in the same units as for Θ. This dimension for k holds for any first order expression in term of concentration units.

As indicated by Equations (21-26), expressions may be set up and integrated for k on the basis of several sets of units. In some instances, it is somewhat easier to use equations set up in terms of units other than concentration units; however, it is felt by the authors that it is simpler to convert available data to concentration units than to work with several different integrated expressions with varying units of k. Consequently, all derivations herein presented are on the basis of concentration units.

Equation (34) pertains to a batch reaction; if a correlation is desired for a continuous reaction, Equation (33) is again applicable as the starting point for the development. On a continuous basis,

$$d\Theta = dV_R/V \qquad (35)$$

where,

V_R = reactor volume
V = volume of the mixture in the reactor per unit time at some given point in the reactor

Equation (35) may be derived by considering the amount of time taken to pass through a given portion of the reactor volume, which is equal to that fraction of the reactor volume divided by the average volume flowing per unit time. Taking limits, Equation (35) results. Substituting Equation (35) into Equation (33),

$$-dN_A/dV_R = k\, N_A/V \qquad (36)$$

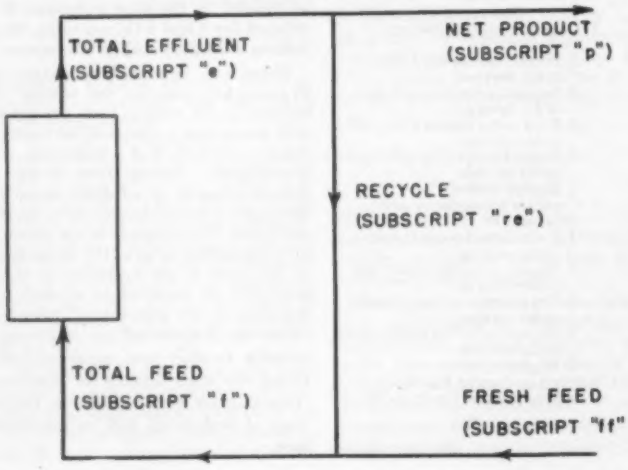
The first integration of Equation (36) will be made on the basis of isothermal, isometric (constant volume) conditions. It will be noted that, neglecting pressure drop in the reactor, or assuming an average pressure in the reactor, a continuous process will occur at constant pressure. Thus, the process will also be constant volume only if the volume of the products is equal to the volume of the reactants, under the pressure constancy. For gaseous systems, this means that the number of mols of gaseous products must equal the mols of gaseous reactants. This isn't necessarily true in a liquid system, since there usually is insignificant volume change during the course of reaction. Thus, a liquid system is usually assumed to be at constant volume for calculation purposes.

For the first order, isothermal, isometric, continuous reaction set-up,

$V_f = V = V_e$
V_f = volume of the feed to the reactor per unit time
V_e = volume of the effluent from the reactor, per unit time

Then, Equation (36) becomes,

Figure 8. Recycle Process.



$$-dN_A/dV_R = k\,N_A/V_f \qquad (37)$$

Separating the variables and integrating,

$$\int_{N_{Af}}^{N_{Ao}} -dN_A/N_A = \int_0^{V_R} (k/V_f)\,dV_R$$

$$\ln (N_{Af}/N_{Ao}) = k\,(V_R/V_f) = k\,\Theta_R \qquad (38)$$

Θ_R = residence time

Note that Equation (38) is identical with Equation (34), if Θ_R is replaced by Θ. Application of the two equations will be, therefore, almost identical.

Since the greater number of applications of first order continuous reactions will be at constant pressure and isothermal conditions, Equation (36) will now be integrated under these conditions. Since V varies throughout the reaction, it is necessary to find a relation between N_A and V, or V_R and V. The relationship used depends on the stoichiometry of the reaction and is as follows, for a gas reaction:

$$V = V_o + \alpha\,(N_{Af} - N_A) \qquad (39)$$

where,

V_o = volume of total feed, including inerts

α = change in volume of mixture per mol of A in feed reacted = $\Delta V/\Delta N_A$

N_A = mols of A at any time in total mixture

$\alpha = \Delta n RT/\pi$, for a perfect gas

Substituting Equation (39) into Equation (36) and integrating,

$$\int_{N_{Af}}^{N_{Ao}} (-dN_A/N_A)(V_o + (N_{Af} - N_A)\,\alpha) = \int_0^{V_R} k\,dV_R$$

$$\int_{N_{Af}}^{N_{Ao}} (-dN_A/N_A)(V_o + \alpha N_{Af}) + \int_{N_{Af}}^{N_{Ao}} +\alpha\,dN_A = \int_0^{V_R} k\,dV_R$$

$$(\alpha N_{Af} + V_o)\ln (N_{Af}/N_{Ao}) + \alpha\,(N_{Ao} - N_{Af}) = k\,V_R \qquad (40)$$

Using the relationship,

$$V_o = (N_F RT/\pi), \qquad (41)$$

the following equation results:

$$(\Delta n\,N_{Af} + N_F)\ln (N_{Af}/N_{Ao}) + \Delta n\,(N_{Ao} - N_{Af}) = (\pi/RT)\,k\,V_R \qquad (42)$$

The use of quation (41) pre-supposes an ideal gas relationship.

An example of the use of Equation (42) is shown below as Example 10:

Example 10: Experimental batch data carried out on the reaction, $A \rightarrow 3C$, showed the reaction to be first order. It was found that 50 percent of A reacts in 25 minutes at 750° F. Assuming the order of the reaction does not change with higher conversion of A, calculate the required reactor volume to carry out the reaction in a once-through continuous operation with 70 per cent conversion of A. The charge rate is to be 3.0 mols per hour. The charge will consist of 90 percent A and 10 percent inerts, on a mol basis. The reaction is completely in the gas phase, and is to be carried out at 750° F. and 25 psia pressure. It may be assumed that the gas law holds at this pressure.

Solution:

The reaction rate constant, k, may be calculated from Equation (34).

$\ln (N_{Af}/N_{Ao}) = k\,\Theta$

$k = \ln (1/0.5)\ (60/25)\text{hr}^{-1}$

$k = 1.665\ \text{hr}^{-1}$

In applying Equation 42,

$\Delta n = 3 - 1 = 2$; $N_F = 3.0$;

$N_{Af} = 0.9 \times 3.0$

$N_{Af} = 2.70$; $N_{Ao} = 0.3 \times 2.70 = 0.81$;

$T = 1210\ ^\circ\text{R}$.

$(2 \times 2.70 + 3.00)\ln (2.70/0.81) + 2\,(0.81 - 2.70) =$

$(25/10.73 \times 1210)\ 1.665\ V_R$

$V_R = 519 \times (10.01 - 3.78)/1.665$

$V_R = 1940$ cubic feet

Equations (40) and (42) hold for any first order continuous process under isothermal, constant pressure conditions, provided that N_{Af} and N_{Ao} refer to total mols of A in the total feed and total effluent, respectively, to and from the reactor. Sometimes, however, the data available will be in terms of the fresh feed and net product of a continuous recycle reactor. The method used here to handle this situation is to calculate the material balances around the reactor and use the results of these material balances in the previously used derived equations. However, it is worthwhile to derive some simple equations for use with a recycle process. A schematic flow diagram for a recycle process is shown in Figure 8. Note that the subscript, *re*, refers to the recycle stream, the subscript, *ff*, refers to the fresh feed, the subscript, *p*, refers to the product stream, and subscripts, *f* and *e*, are used as described above. By material balance,

$$N_{Af} = N_{Afe} + N_{Aff}$$

$$V_f = V_{re} + V_{ff}$$

Since total mols of a component in a stream are equal to the concentration per unit volume times the volume,

$$C_{Af}\,V_f = C_{Afe}\,V_{re} + C_{Aff}\,V_{ff}$$

$$C_{Af} = C_{Afe}\,[V_{re}/(V_{re} + V_{ff})] + C_{Aff}\,[V_{ff}/(V_{re} + V_{ff})] \qquad (43)$$

In the last equation, $V_{re} + V_{ff}$, was substituted for V_f. Recycle ratio, R, is,

$$R = V_{re}/V_{ff}$$

And, since the product stream, the recycle stream, and the total effluent stream have the same composition (See Figure 8),

$$C_{Afe} = C_{Ae} = C_{Ap}$$

Substituting these last two relationships into Equation (43),

$$C_{Af} = C_{Ap}\,[R/(1+R)] + C_{Aff}\,[1/(1+R)] \qquad (44)$$

Substituting back into Equation (38),

$$\ln (N_{Af}/N_{Ae}) = \ln (C_{Af}\,V_f/C_{Ae}\,V_e) = k\,V_R/V_f \qquad (45)$$

From Equation (44),

$$C_{Ae}/C_{Af} = C_{Ae}/[1/(1+R)\ [(C_{Ap}\,R + C_{Aff})] \qquad (46)$$

$$C_{Ae}/C_{Af} = C_{Ap}\,(R+1)/(C_{Ap}\,R + C_{Aff}) \qquad (47)$$

And, since $V_e = V_f$ (Constant volume process),

$$\ln \left\{ (R\,C_{Ap} + C_{Aff})/[C_{Ap}\,(1+R)] \right\} = k\,V_R/V_f \qquad (48)$$

The use of Equation (48) is exemplified.

Example 11: Experimental data were obtained in a constant volume bomb at 350° F., on isomerization of normal pentane to isopentane by catalytic action of aluminum bromide* as shown in Table A:

TABLE A

Time, Minutes	Analysis, Mol. Percent	
	Normal Pentane	Isopentane
0	100.0	0.0
60	80.5	19.5
150	58.0	42.0
235	44.0	56.0

What residence time must be provided in the reactor of a commercial unit operating continuously to provide a product stream containing 45 mol percent isopentane? Available charge stock analyzes 95.0 percent normal pentane and 5.0 percent isopentane. Calculate the residence time for (1) a once-through process, (2) a recycle process with a recycle ratio of 1, (3) a recycle process with a recycle ratio of 5, and (4) a recycle process with a recycle ratio of 10.

Solution:

Equation (34) may be used to determine the value for k, and to check the order of the reaction,

$$\ln (100/44) = 225\,k$$

$$k = 0.00364\ \text{min}^{-1}$$

A check at intermediate points shows a constancy of values for k, thus showing the reaction is of first order.

* Note: The data at high conversions in this problem have been estimated by extrapolating the data at low conversions, on the basis of an irreversible reaction. It is realized that this reaction is reversible, and that in an actual design this fact would have to be taken into account, as shown later in Equation 65.

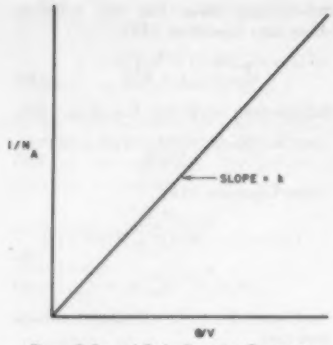


Figure 9. Second Order Reaction Constant.

(1) $\ln (N_{Aft}/N_{Ae}) = k\,\Theta$
$\ln (0.95/0.55) = 0.00364\,\Theta$
$\Theta = 150$ minutes.

(2) Applying Equation (48),
$\ln [(1 \times 0.55 + 0.95)/(2 \times 0.55)] = 0.00364\,\Theta_R$
$\ln (1.50/1.10) = 0.309 = 0.00364\,\Theta_R$
$\Theta_R = 84.8$ minutes.

(3) Applying Equation (48),
$\ln [(5 \times 0.55 + 0.95)/(6 \times 0.55)] = 0.00364\,\Theta_R$
$\ln (3.70/3.30) = 0.1133 = 0.00364\,\Theta_R$
$\Theta_R = 31.2$ minutes.

(4) Applying Equation (48),
$\ln [(10 \times 0.55 + 0.95)/(11 \times 0.55)] = 0.00364\,\Theta_R$
$\ln (6.45/6.05) = 0.064 = 0.00364\,\Theta_R$
$\Theta_R = 17.6$ minutes.

In (1), $V_f = V_{ff}$, and the volume required, as a basis of comparison may be taken as 150 units. In (2), $V_f = 2\,V_{ff}$, and the comparative volume would be 84.8×2, or 169.6 units. In (3), $V_f = 6\,V_{ff}$, and the comparative volume would be 31.2×6, or 187.2 units. In (4), $V_f = 11\ V_{ff} = 17.6 \times 11$, 193.6 units. Thus, the required volume for the reactor continuously increases according to these ratios, as required residence time decreases.

Example 12: **Assuming the residence time constant at 84.8 minutes, in the above example, and the conversion, for a continuous recycle process with a recycle ratio of 1, to be to 45 percent isopentane in the effluent, calculate the concentration of isopentane in the effluent for recycle ratios of 5 and 10. Compare the required reactor volumes for these three cases.**

Solution:

For a recycle ratio of 10, applying Equation (48),

$\ln [(10 \times C_{Ap} + 0.95)/(11\,C_{Ap})] = 84.8 \times 0.00364 = 0.309$
$(10\,C_{Ap} + 0.95)/(11\,C_{Ap}) = 1.362$
$15\,C_{Ap} - 10\,C_{Ap} = 0.95$
$C_{Ap} = 0.19$

Thus, the concentration of isopentane in the effluent is 81 percent. The comparative reactor volume is 84.8×11, or 932 units.

For a recycle ratio of 5, applying Equation (48),

$\ln [(5 \times C_{Ap} + 0.95)/(6\,C_{Ap})] = 84.8 \times 0.00364 = 0.309$
$(5\,C_{Ap} + 0.95)/(6\,C_{Ap}) = 1.362$
$8.18\,C_{Ap} - 5\,C_{Ap} = 0.95$
$C_{Ap} = 0.299$

Thus, the concentration of isopentane in the effluent is 70.1 percent. The comparative reactor volume is 84.8×6, or 509 units. This compares with 169.6 units for a recycle ratio of 1.

Although Equation (48) was derived by substituting Equation (44) into Equation (38), it may be seen that Equation (44) may be substituted into any of the derived equations, and the corresponding recycle equation may be obtained. Since, as mentioned above, the usual procedure is to make separate material balances and apply the derived equations for a once-through process, no further work will be done along this line.

The expression for a second order reaction, in terms of concentration units may be set down from Equation (26):

$$-dN_A/Vd\Theta = k_C\,C_A\,C_B \qquad (49)$$

Substituting for C_A its value, N_A/V, and cancelling the V terms on both sides of the equation,

$$-dN_A/d\Theta = k\,N_A\,C_B \qquad (50)$$

Equation (50) holds for the reaction,

$$A + B \rightarrow \text{Products},$$

assuming the reaction is irreversible. To integrate Equation (50), C_B must be obtained in terms of the mols of B in the feed, N_{Bf}, and in terms of N_A, the mols of A present at any time:

$$C_B = N_B/V$$

Since A and B react mol for mol,

$$N_{Bf} - N_B = N_{Af} - N_A \qquad (51)$$

Thus,

$$C_B = (N_{Bf} - N_{Af} + N_A)/V \qquad (52)$$

For an isothermal, isometric process, V is constant.

$$-dN_A/d\Theta = k\,N_A\,(N_{Bf} - N_{Af} + N_A)/V \qquad (53)$$

Separating the variables and integrating, the final equation is

$$[1/(N_{Bf} - N_{Af})] \ln (N_{Af}\,N_{Be}/N_{Ae}\,N_{Bf}) = k\,\Theta/V \qquad (54)$$

It will be noted that there is an apparent discrepancy in the above equation when stoichimetric feeds are employed. In that case, $N_{Bf} = N_{Af}$, and Equation (54) becomes indeterminate. To remedy this situation, the differential equation for the second order reaction, Equation (50), is rewritten,

$$-dN_A/d\Theta = k\,N_A\,N_A/V \qquad (55)$$

This is true, since,

$C_B = N_B/V$, and $N_A = N_B$ at all times.

Separating the variables and integrating,

$$1/N_{Ae} - 1/N_{Af} = k\,\Theta/V \qquad (56)$$

Values of k may be found by substituting appropriate data in Equations (54) or (56), or by graphing the data. As shown in Figure 9, if Θ/V is plotted against $1/N_A$, the slope of the line will be equal to k. A straight line will result, if the reaction is of second order. Use of Equation (54) is illustrated below in Example 13:

Example 13: Compounds A and B are charged to a bomb at 200° F. and 1 atmosphere pressure. The stoichiometry of the reaction is, $A + B \rightarrow C$, and experiments at lower temperatures show the reaction is second order. Three mols of A are charged, per mol of B. After reacting for 30 minutes, one-fourth of A has reacted. Calculate k.

Solution:

This is an isothermal, isometric second order reaction, with unequivalent feeds. Equation (54) applies.

$N_{Af} = 3$ mols; $N_{Ae} = 2.25$ mols
$N_{Bf} = 1$ mol; $N_{Be} = 0.25$ mols
$V = nRT/\pi =$
(4) (10.73) (660) (14.7) = 1950 ft³
$[1/(N_{Bf} - N_{Af})]$
$[\ln (N_{Af}\,N_{Be}/N_{Ae}\,N_{Bf})] = k\Theta/V$
$[1/(1 - 3)]\ [\ln (3 \times 0.25)/(2.25 \times 1)] = 30\,k/1950$
$k = (1950/30)\ (0.5 \times 1.099) =$
35.7 min⁻¹ ft³ mols⁻¹

It is interesting to note the units of the second order reaction rate constant at this point. The units of the left hand side of Equation (54) are mols^{-1}. The units of Θ/V on the right hand side are min/ft.³ (Other time and volume units could be used; however, these seem the most logical for engineering work). Therefore, to make the units of the right hand side consistent with the units of the left hand side, the units of k must be mols^{-1}ft^{3}min.$^{-1}$.

End of Part II. Part III will appear in an early issue.

* * *

THIS THREE-PART REPORT of the development of bubble tray pressure drop calculation methods is along the lines of basic theory and has proven of much interest to designers. Part I appeared in the June issue and Part II in the August issue of PETROLEUM REFINER.

Dr. Huntington is chairman of the School of Chemical Engineering, University of Oklahoma, and Dr. Huitt, now with Magnolia Petroleum Company, Dallas, was a former faculty member there.

Pressure Drop Through Bubble Caps

Part III. Application of Theoretical Equations

J. L. HUITT and R. L. HUNTINGTON
University of Oklahoma, Norman

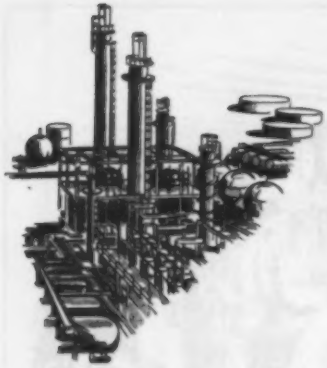
WHEN calculating the pressure drop through bubble caps to be expected for a given condition of flow for the vapor and liquid on the tray there are many points to consider. From the results of this investigation, Equations 22 and 23 and Figures 6 and 8 are of primary importance, but only to the extent to which the variables in these equations are known. These equations cannot be applied to a whole column in the sense that all caps will have the same pressure drop. To be rigorous, the equations should be applied to each individual cap, but of course this is not desirable. The next best result would be to apply them to all the caps on a single tray. To be applied to all the caps on a tray, certain points have to be kept in mind when evaluating certain variables. The following discussion treats each term in Equation 23 separately as to what pressure drop that term refers.

The pressure drop, ΔP_s, due to the static height of liquid above the slots is not the same for all the caps. This pressure drop is influenced by three factors which are difficult to control; namely, the hydraulic gradient, the aeration of the liquid including foaming, and the change in density as the liquid transverses the tray. The last of these is negligible in most operations. The hydraulic gradient would have to be considered when arriving at a value for the seal in Equation 23.

The minimum seal would be the difference between the top of the slot and the height of the liquid above the slot as it crosses the exit weir. One investigation[5] shows this is not always the case, but at normal flow rates it is thought the minimum height of liquid on the tray would be at the exit weir, and can be calculated from the weir formula knowing the liquid flow rates and weir width. Rhys and Minich,[6] Davies,[1] and Good et al.[2] offer methods of calculating the liquid gradient. From this the average height of the liquid on the tray can be obtained and the average seal calculated. It is recommended this average seal be used in Equation 23. If there is a foaming tendency of the liquid, this correction also has to be applied to the seal. Souders et al.,[8] Holbrook and Baker,[3] and Sherwood and Jenny[7] offer a discussion of this problem and its effect on the liquid height. This correction should also be applied to the average seal.

The aeration effect is greatest at high vapor rates, and quite often the equivalent liquid height under static conditions on the tray is equivalent to only a fraction of the actual height of the aerated liquid. If the density of the liquid be taken at static conditions, the density must be multiplied by an aeration factor. Kemp and Pyle[4] offer a means of estimating these factors and the hydraulic gradients encountered on bubble cap trays. Thus with these points in mind the pressure drop due to the liquid seal can be calculated.

The pressure drop, ΔP_i, caused by the static head of liquid which is just opposite the slot should offer little difficulty in calculation. For the average pressure drop due to this particular factor, the flow of vapor has to be assumed split equally among all caps. The length has to be greater than the minimum length of slot opening interpolated from Figure 6 before vapor can flow through the slot. If this length is less than that obtained using Figure 6, the slot will operate only intermittently as the pressure below the cap builds up. If the length calculated is above the minimum, this length is used in Equation 25. If the calculated length of the slot operating is above the actual length, the actual



length should be used if there is no skirt clearance for the cap. If there is a skirt clearance for the cap, Equation 22 will also serve to determine the flow of vapor necessary for the full slot to operate. The excess vapor will pass through the skirt clearance. This skirt clearance can be broken up into "skirt slots" having width equal to the width of a slot plus the width of the metal between the slots. Then Equation 22 can be used to determine the length of the skirt clearance operating by using the width mentioned above and the excess of vapor above that required for the full slot to be opened. In all cases when dealing with the density of the liquid, the aeration factor discussed previously should be applied to the density.

In determining the pressure drop, $\Delta P\delta$, caused by the surface tension, the calculation can be made readily after the length is determined. The width of the slot and the surface tension of the liquid at that particular temperature have to be known. This effect is rather small, and once the slot is fully operating, it is assumed to be zero as mentioned in a previous discussion of this effect.

The pressure drop ΔP_o, due to the "orifice effect" offers no problem once the length of the slot operating is determined. Again the flow of vapor is assumed to be equally distributed among all caps and all caps flowing when this calculation is made. If the cap has a skirt clearance that is passing vapor, this pressure drop will have to be separated into two parts. The amount of vapor flowing through the slot and from the "skirt slot" have to be determined as mentioned above. These two quantities are treated separately, using the actual length and width of the slot for that quantity of vapor to cause the slot to be fully opened, and the width and actual operating length of the "skirt slot" for the vapor in excess of that required for the slot to be fully opened. These two calculated values when added will give the pressure drop due to the orifice effect.

The pressure drop, ΔP_r, caused by the expansion, contraction, and flow reversal of the vapor in the riser and cap offers little difficulty. The various areas through which the flow is directed have to be considered in determining the factors causing the greatest restriction to flow. The equation offered in this work is for these various areas being equal. If these various flow areas are not equal, Davies[1] offers the best method of calculating this pressure drop.

During the course of this study on the pressure drop through bubble caps, certain theories were advanced from time to time. The following paragraph is not substantiated by experimental data, but it is thought it merits consideration.

It is believed the pressure drops through all the caps on a single tray are equal, but the various individual portions of the pressure drop may vary from cap to cap. For example, if the static head above one cap is greater than a second cap, the vapor will be distributed so as to make the pressure drop the same for both caps. This is true even if a cap is not flowing vapor or is even permitting the liquid to flow through the cap to the tray below. In the latter case the friction caused by the liquid flow would consume that portion of the static head in excess of the pressure drop of a cap flowing vapor. If the excess static head were not offset, the tower would become flooded.

Equations 22 and 23 and Figure 6 can be of great help in analyzing a situation of this type. If the liquid gradient is known, the seals above the caps can be determined. Then the various quantities of vapor going to each cap can be determined by remembering that the pressure drops have to be equal. This would necessitate a trial and error solution since the actual operating lengths of slots would have to be calculated by Equation 22, and the pressure drop due to the slot opening effect would have to be considered. Since experimental data are not attainable the quantitative value of these equations in analyzing this problem cannot be determined. However, the equations present a very useful qualitative solution to the problem.

Conclusions

The conclusions which are the results of this investigation are:

1) There is a minimum length of slot opening below which the vapor will not pass through the slot into a liquid having a finite surface tension.
2) The length of the minimum slot opening is a function of the slot width and the surface tension of the liquid.
3) There is a pressure drop through the slots caused by the surface tension of the liquid.
4) The equations presented are of value in calculating the pressure drop through bubble caps.
5) The equations presented can be used in analyzing problems of mal functioning bubble caps and trays.

(End of Part III and series.)

ACKNOWLEDGMENT

The authors wish to express their appreciation to the Socony-Vacuum Oil Company for the sponsorship of the Magnolia Fellowship under which this research was supported.

LITERATURE CITED

[1] Davies, J. A., Petroleum Refiner, 29, 8, 98 (1950); 29, 9, 121 (1950).
[2] Good, A. J., Hutchinson, M. H., and Rosseau, W. C., Industrial and Engineering Chemistry, 34, 1445 (1942).
[3] Holbrook, G. E., and Baker, E. M., Industrial and Engineering Chemistry, 30, 1063 (1934).
[4] Kemp, H. S., and Pyle, C., Chemical Engineering Progress, 45, 435 (1949).
[5] McCarthy, E. L., M. Ch. E. Thesis in Chemical Engineering, University of Oklahoma (1949).
[6] Rhys, C. O., Jr., and Minich, H. L., "Fractionator Tray Performance and Design," A Technical Paper presented at the Los Angeles Regional Meeting of the American Institute of Chemical Engineers, March 6-9, 1949.
[7] Sherwood, T. K., and Jenny, F. J., Industrial and Engineering Chemistry, 27, 265 (1935).
[8] Souders, M., Jr., Huntington, R. L., Cornell, H. G., and Emert, F. L., Industrial and Engineering Chemistry, 30, 85 (1938).

* * *

"Largest in Europe" is the tag given Shell's new Rotterdam refinery which has just been completed. Picture above shows a view of the cat cracker, first to be constructed in Europe. Left to right: Stack of the furnace, 196 feet high; catalyst hoppers and, at top, conveyor for catalyst. In front is the compressor house and in the background, right, the fractionating column.

Europe's First Modern Catalytic Cracker is Completed

E. N. TIRATSOO, London

JUST completed at the Shell Pernis refinery, near Rotterdam in Holland, is the first modern-type catalytic cracking unit to be constructed in Europe. After taking nearly two years to build, it is due to come into full operation shortly with a capacity of about 28,000 barrels daily.

With this new plant, an important part of the postwar rehabilitation and new construction program of the Pernis refinery, now the largest in Europe, has been completed. War-damage repairs brought its capacity during 1946 back to the prewar level of seven million barrels a year, and subsequent expansion has raised the figure up to 35 million barrels a year. Some $60 million has been spent on this program since 1945, of which this "cat-cracker" has taken a substantial part.

Gas for Cities

Valuable gases obtained as a by-product of the cracking process are to be supplied to the nearby municipalities of Rotterdam and The Hague to supplement the supply of town's gas for domestic use. A pipe line is to be built from Pernis to Rotterdam for this purpose.

The new extensions at Pernis form part of Shell's over-all postwar refinery expansion program which, including in-

Part of the catalytic cracker at Shell's Pernis refinery is shown here. White rectangular structure in front is the regenerator with the lift. The fractionating column can be seen to the right.

stallations in France, Germany and Italy, has now made the company by far the largest refinery operator in Europe with a total annual capacity of some 140 million barrels.

For the primary processing of crude oil, the Pernis refinery has three distillation units which have at the moment a thruput of about 84,000 barrels per day. In addition to these distillation units there are two high-vacuum installations, one of which processes asphaltic residues into asphalt while the other distills waxy distillates off from wax residues. The waxy distillates are dewaxed in a solvent dewaxing plant. A part of these distillates is then purified with sulfuric acid and clay in a dry refining plant. The refined lubricating oils are mainly dispatched packed, a filling plant having recently been taken into service for this purpose.

The slack wax obtained during the dewaxing process is cracked in two vapor-phase cracking units. From the cracked distillate obtained in this way, a fraction is separated off by fractional distillation. This fraction is rich in olefins and forms an excellent base material for the manufacture of detergents.

The asphalt works comprises blowing plants for the manufacture of fully-blown and semi-blown asphalts, plants for the manufacture of cut-back asphalts, and asphalt emulsions. There is also a large filling plant for packing the various asphalt products.

Dubbs Thermal Cracking Unit

For the manufacture of gasoline from residual base materials, there is a Dubbs thermal cracking unit. Part of this unit is equipped for the selective cracking of paraffin-base materials into gas, gasoline and fuel oil, while, in another part, asphalt-base materials are processed into gas, gasoline and petroleum coke.

A fluid bed catalytic cracking plant, just completed, will shortly be in operation. This plant is fed from a feed "preparator," in which long residue is processed into distillates and short residue.

Sulfur Conversion

The refinery also contains a thermal reforming plant in which gasoline with a low octane rating is converted into a higher quality gasoline. For further processing of the cracked gases obtained during the various cracking processes, a number of plants have been built in which the gases are purified and split up into valuable components, such as butane and propane. The hydrogen sulfide from these purification plants is converted into sulfur in a Claus kiln installation.

For the purification of thermally cracked gasoline there is an acid refining and redistillation unit. All gasolines are treated to improve their odor in two "doctor" treaters. In order to meet the demand for special gasolines for industry, a gasoline redistillation unit is in use. An acid refining plant for kerosine makes it possible to manufacture purified lamp kerosine.

In a tetraethyl lead mixing unit the finished motor gasolines are mixed.

Big Waterfront

The total waterfront of the Pernis refinery, including tank farms, covers three and one-half miles. Altogether there are 19 jetties for tankers, coasters and tank lighters. Seven tankers, including the modern 28,000 ton "super" tankers can berth at the same time. The total discharging capacity is 6000 cubic meters per hour. The total area of the refinery is 900 acres, 550 acres of which are covered by buildings. The storage capacity amounts to 1.2 million tons.

The VAPOR PRESSURE Of Gasoline

GEO. E. MAPSTONE, Chief Chemist, National Oil Proprietary Ltd.

Glen Davis, 6W, N.S.W., Australia

THE vapor pressure of gasoline is often used as a quality characteristic for process control as well as being included in the specifications for the quality of the finished product. The vapor pressure is normally determined at 100° F. by the Reid method (ASTM D 323-49, I.P. 69/45). In this method part of the sample is allowed to evaporate, the volume of vapor space being within the limits of 3.8 to 4.2 times the volume of liquid sample. This evaporation causes a small change in the composition of the sample but, since the method has been standardized such changes do not affect the value and application of the vapor pressures obtained.

Correction of Bomb Pressure to Gasoline Vapor Pressure

The air initially present in the air chamber of the Rvp. bomb expands on being warmed from its initial temperature to the bath temperature. To get the true gasoline vapor pressure this increase in pressure must be subtracted from the observed pressure reading, as must the increase of pressure due to the evaporation of some of the water also present. This total correction factor is given by

A NOMOGRAPH is presented which will determine the pressure correction to be applied to the Rvp test to correct for the initial air chamber temperatures, bath temperature and barometer pressure. A relationship between the vapor pressure of a variety of gasoline samples as determined by the Reid method, and the bath temperature has also been derived and is presented in the form of a nomograph.

$$C = \frac{(B - P_1)(t_1 - t_2)}{460 + t_1} - (P_2 - P_1)$$

where C = correction factor psi.

B = barometric pressure psi.

t_1 = initial air chamber temperature °F.

t_2 = bath temperature °F.

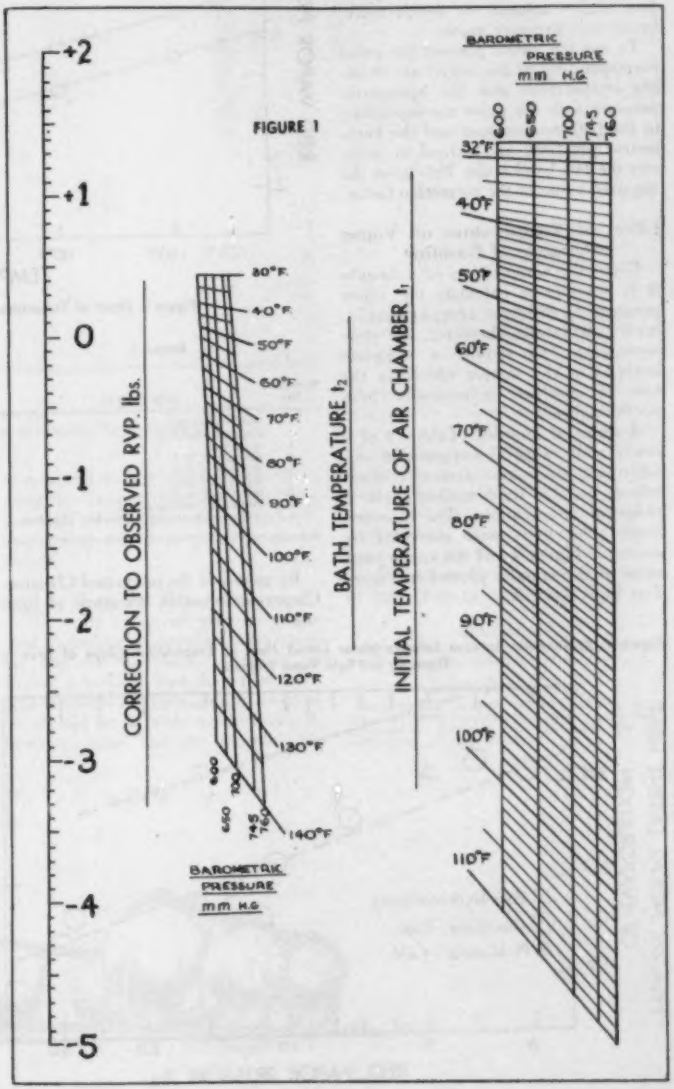
P_1 = vapor pressure of water at t_1 °F.

P_2 = vapor pressure of water at t_2 °F.

ASTM D 323-49 specifies the temperature of the bath at 100° F. while I.P.—69/45 allows the bath to be kept at other temperatures if required.

It has also sometimes proved to be convenient if the vapor pressure could

FIGURE 1



be corrected for errors in bath temperature so the general form of the above equation has been dealt with. The equation may be rearranged in the form

$$C = (B - P_2) - \frac{460 + t_2}{460 + t_1}(B - P_1)$$

Since P_2 is a function of t_2, and P_1 a function of t_1, this equation is then suitable for presentation in nomographic form (for constant values of B). A separate nomograph was prepared for each of several values of the barometric pressure and the resultant charts superimposed and correlated in Figure 1, in which the two temperature scales appear as temperature-barometric pressure mazes.

To use the chart, connect the point corresponding to the initial air chamber temperature and the barometric pressure with the point corresponding to the bath temperature and the barometric pressure, and extend to intersect the left hand scale. This gives the required value of the correction factor.

Effect of Temperature on Vapor Pressure of Gasoline

Given the composition of a sample it is possible to calculate the vapor pressure at different temperatures. Such calculations, however, are time consuming and require a complete analysis of the sample which, in the case of gasolines is normally quite unobtainable.

A series of samples (Table 1) of a fairly wide range of composition was taken and the vapor pressures determined by the Reid method over a range of temperatures. The observed bomb pressures were corrected by means of Figure 1 and the vapor pressures of the samples plotted in Figure 2 as log P vs. I/T.

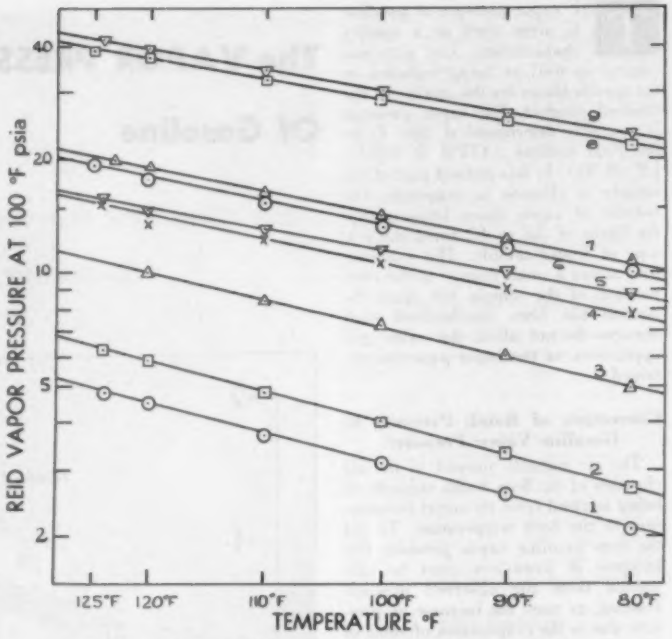


Figure 2. Effect of Temperature on Vapor Pressure of Gasoline.

Table 1

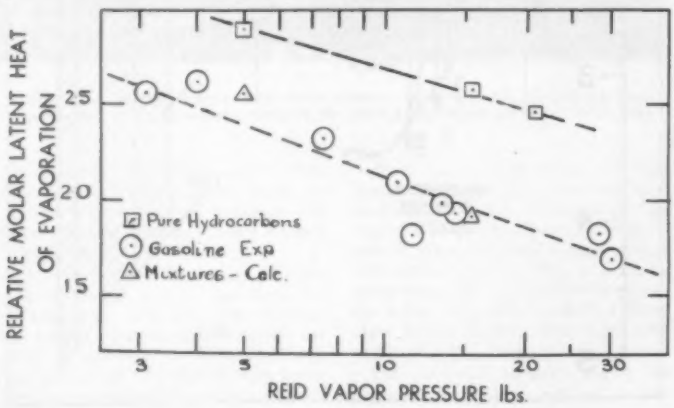
Sample No.	Description
1.	Shale Naphtha
2.	Cracked Gasoline
3.	Gasoline
4.	Samples 3 + 8
5.	Samples 1 + 9
6.	Samples 3 + 9
7.	Samples 3 + 9
8.	Butanized absorption oil
9.	High vapor pressure Polymer Gasoline

By means of the integrated Clausius-Claperyon equation the slope of lines may be related to the molar latent heat of evaporation of the samples. The straight-line relationship obtained indicates that the latent heats do not vary significantly over the temperature range involved. (Figure 2.)

In order to obtain a general relationship involving all the samples examined the relative slopes i.e, relative molar latent heats of evaporation were plotted against the vapor pressure at 100° F. (i.e. Rvp.) in Figure 3. For comparison the corresponding data for n-hexane, n-pentane and isopentane were included together with that of a n-butane - n-undecane mixture of the same Rvp. as n-pentane and a n-pentane - n-undecane mixture of the same Rvp. as n-hexane. The latent heats of the mixtures correspond well with those of the gasoline mixtures but those of the pure hydrocarbons were significantly different.

Lippincott and Lyman[1] have published a good nomograph for the correlation of vapor pressure and temperature of pure components which is based on a modification of the integrated Clausius-Claperyon equation. Unfortunately their nomograph cannot be applied directly to mixtures because of the discrepancies between the latent heats of evaporation but, since a similar relationship was observed for the gasoline samples in Figure 3 as for the pure hydrocarbons, a similar nomographic relationship could be ex-

Figure 3. Relationship between Relative Molar Latent Heat of Evaporation (slope of lines in Figure 2) and Reid Vapor Pressure.



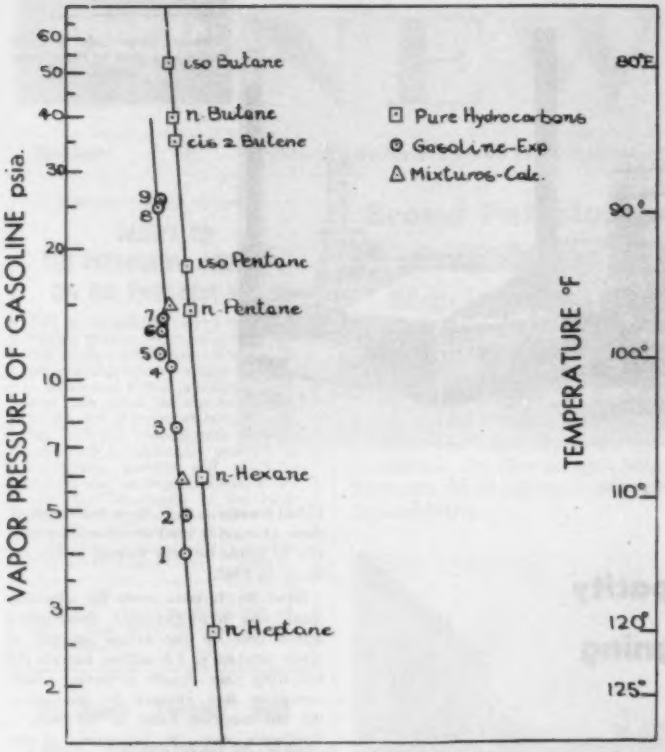


Figure 4. Nomographic Correlation of Gasoline Vapor Pressure.

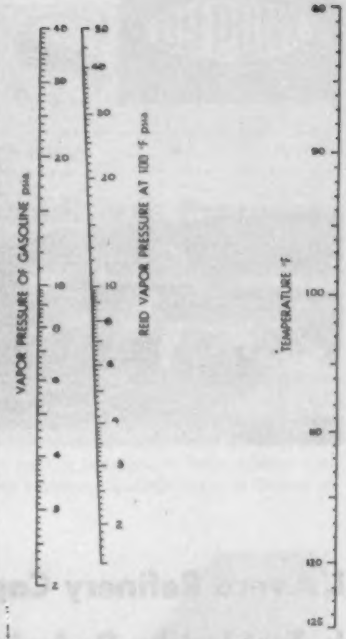


Figure 5. Vapor Pressure Temperature Nomograph.

pected. This relationship was found to be sufficiently close (Figure 4) to allow the preparation of a nomograph for the determination of the vapor pressure of a gasoline sample at various temperatures given the vapor pressure at any one temperature (Figure 5).

To use the nomograph, connect the observed vapor pressure of the gasoline (after correction by Figure 1) to the temperature with a straight edge and read off the Rvp. of the sample on the middle scale. If the vapor pressure is required at any other temperature, pivot the straight edge about the Rvp. and read off the temperatures and corresponding vapor pressures as required.

General Remarks

The wide range of samples examined including a butanized absorption oil and the correlation obtained in Figure 4 indicate that the vapor pressure-temperature nomograph (Figure 5) should be of wide application. If, however, some gasoline sample may be suspect as not complying with that relationship the Rvp. could be determined at two or more different temperatures (using Figure 1 to obtain the bomb pressure correction). The lines joining the observed gasoline vapor pressures to the corresponding temperatures should intersect in a common point. If Figure 5 is applicable to the sample this point will be on or very close to the middle scale.

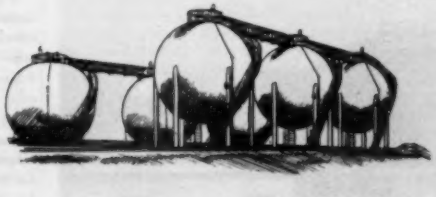
REFERENCE

[1] Lippincott, S. B., and Lyman, M. M., Ind. Eng. Chem., **38**; 320-322, (1946).

ACKNOWLEDGMENT

The author wishes to acknowledge with thanks, the permission granted by the management of National Oil Pty. Ltd., for the publication of this paper.

* * *



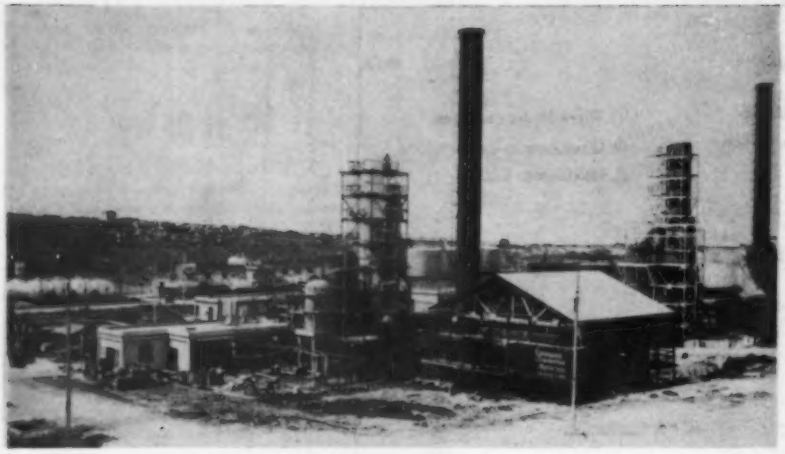


Photo shows side view of cracking plant at the L'Avera refinery.

L'Avera Refinery Capacity Is Trebled by Redesigning

THE L'Avera refinery, situated 25 miles west of Marseilles, was erected by Societe Generale des Huiles de Petrole, an affiliate of Anglo-Iranian, in 1933. Its original capacity was 6500 barrels per day which was stepped in 1938 to 10,800 barrels. Because of the drying up of crude oil supplies in wartime the refinery was shut down and put on a care-and-maintenance basis.

After the war the state of French economy rendered it imperative to increase refinery throughput, while currency difficulties and paucity of steel precluded purchase of foreign equipment or new process units as a solution to the problem. The company's management in Paris and the staff at L'Avera displayed much ingenuity and enterprise and met these demands without major constructional efforts entailing installation of new equipment.

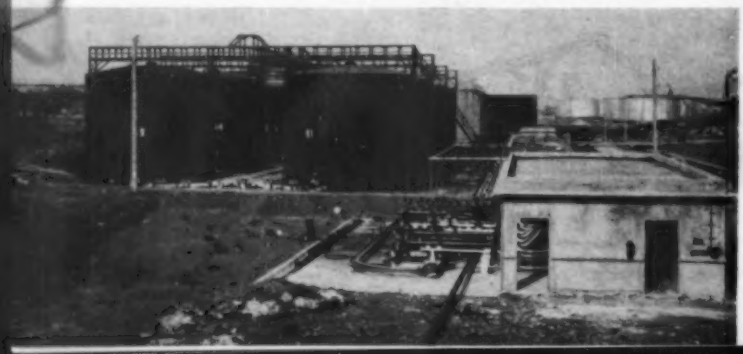
For a start, alterations were made to convert the vacuum distillation unit to normal distillation work. Thus an extra throughput of 7064 barrels a day, rising later to 12,008 barrels daily, was achieved. Meanwhile modifications made to the existing topping unit raised its capacity from the designed 12,008 to 15,540 barrels a day. As a net result of these changes a total of 5.6 million barrels of crude oil was treated at the refinery in 1947.

Next the furnace from the cracking plant was brought into commission which sent up the actual amount of crude worked to 7.8 million barrels the following year. Lastly a further transformation was effected by converting the old cracking plant of 1933 into a distillation unit. By revamping of old units in this way the refinery throughput was stepped up to 9.9 million barrels in 1949, and its current annual capacity is 11.3 million barrels, nearly treble the prewar figure.

This trebling of the rated throughput threw in turn a heavy load on auxiliary services, water, power, steam, storage and transport. These were met by moving unwanted boilers from Courchelettes, installing new tankage and increasing water and power supplies. Mediterranean sea water is used for cooling the refinery. Water for domestic and drinking purposes is produced by sinking wells in the refinery site and from the town of Martigues two miles away. The boiler house has nine boilers, and electricity is produced by five alternators driven by diesel engines and is augmented by import from the grid (E.D.F.).

The L'Avera refinery now produces liquid petroleum gases (propane and butane), special solvents, regular grade, supergrade and special motor gasolines, burning oil, gas oil, diesel oil and fuel oils of several different grades. Propane and butane are pumped to a distribution depot just outside the refinery where there is a complete installation for handling and loading into containers for domestic and industrial use.

Black Oil Tankage and Pump House at L'Avera, France, Refinery.



DU PONT **PETROLEUM CHEMICALS DIVISION NEWS** DU PONT

October ★ *One of a Series of Interest to the Petroleum Industry* ★ *1951*

SALUTE TO THE PETROLEUM INDUSTRY ON OIL PROGRESS WEEK

Just as Spindletop roared in with a mighty gusher 50 years ago, so has our modern civilization—powered by petroleum products—surged ahead.

More and better petroleum products have paved the way to progress in industry, in transportation, in farming, in home conveniences. And today, such revolutionary products as detergents, plastics and synthetic rubber play an important role in our everyday life—thanks to the basic materials supplied by an alert, progressive petroleum industry.

Du Pont is proud of its contributions to oil progress, too . . . with explosives, paints, neoprene and many other products . . . and proud of its work with refiners in developing additives that make for superior fuel performance.

Du Pont "Zerone" and "Zerex" Formulated to Meet Varying Customer Needs

Climate, altitude, driving conditions and mechanical design of the car all have a bearing on the type of anti-freeze a motorist needs for efficient cooling system operation. That's why Du Pont makes two distinctly different types of anti-freeze —"Zerone" and "Zerex." Both are well known to millions of motorists the country over.

"Zerone" is made to meet the requirements of 4 out of 5 motorists for complete winter protection. It contains a chemical-type rust inhibitor to protect the radiator from corrosion.

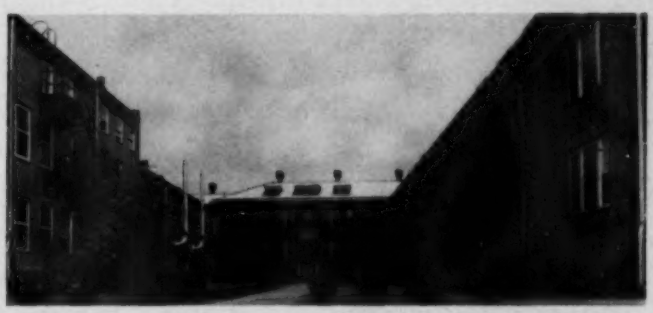
"Zerex" is specially made for such extraordinary conditions as high opening thermostats, high altitudes, heavy-duty driving and temperatures colder than 30°F. below zero. Its chemical rust inhibitor helps to keep the entire cooling system clean and free from rust and corrosion.

In addition, Du Pont has prepared a cooling system manual to help service station operators build additional business with a complete cooling system service. It deals with many common cooling system problems and gives complete instructions for both summer and winter conditioning. The manual is available through wholesale distributors of "Zerone" and "Zerex."

Broad Petroleum Additives Program Aims at Providing Maximum Assistance for Refiners

How CAN Du Pont's extensive chemical research and manufacturing experience be of greatest help to the refinery industry?

The answer to that question, posed more than a quarter century ago, ultimately led to Du Pont's development of a complete line of gasoline additives . . . tetraethyl lead compounds, dyes, antioxidants and Metal Deactivator. In addition, Du Pont set up a broad service program to help refiners and marketers obtain maximum uniformity, economy and efficiency in the use of these additives.



THE JACKSON LABORATORY, located near the Du Pont Chambers Works TEL manufacturing area, was the scene of many early developments in TEL and other petroleum additives.

Du Pont's close cooperation with the petroleum industry started on additive problems back in the early 20's with the development of tetraethyl lead. The safe commercial manufacture of this important antiknock compound was first accomplished by Du Pont scientists and, until recently, Du Pont was the sole manufacturer of this product.

At about the same time, dyes also became an important factor in gasoline marketing. This was brought about in part by the Surgeon-General's recommendations that gasoline containing TEL must be identified by distinctive coloring.

Since Du Pont had been developing dyes as early as 1915, when World War I cut off the German supply, the Company was again able to make a substantial contribution to the petroleum industry. For Du Pont had already poured millions of dollars and years of research into the task of perfecting uniform, economical dyes for many uses.

Today, Du Pont manufactures and sells gasoline dyes conforming to the rigid standards that have been established through many years of research and experience.

But Du Pont's interest in gasoline additives did not stop with TEL and dyes alone. The problem of keeping cracked gasolines gum-free during long periods of storage brought about the development of Du Pont Gasoline Antioxidants. Sulfuric acid, both costly and contributing to treating losses, had previously been used for this purpose. With antioxidants, however, due to

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

OVER

DU PONT

PETROLEUM CHEMICALS DIVISION
NEWS

DU PONT

CONTINUED *Additives Program*

their effectiveness even in small concentrations, refiners were able to produce finished gasoline at lower treating costs.

Today, antioxidants are almost as important to the production of high quality gasoline as is tetraethyl lead. And they are especially important to the defense effort because of the oxidation problems involved in stockpiling gasoline.

Still alert to problems and desired improvements in refining, Du Pont added Metal Deactivator to its line. Until 1937, there had been little need for this product. Then copper sweetening came into the picture. This was a distinct advance in refining, but, unless handled with care, traces of copper might remain in the sweetened gasoline. This copper is a highly active catalyst in the oxidation of the unsaturated constituents in the end product.

Obviously, there was a need for deactivating even minor traces of copper —and Du Pont Metal Deactivator met this need. Thus more refiners have benefited from the advantages of this process.

Du Pont has set up a complete program of technical services for the petroleum industry with a large staff of

SINCE 1923, Du Pont has manufactured TEL in these buildings at the Chambers Works, Deepwater, N. J. Here, the first safe method of producing tetraethyl lead compounds was accomplished on a commercial scale.

competent personnel especially trained in the use of all gasoline additives. Services also include promotion and dealer training aids for marketers, as well as safety, medical and research help for refiners. And besides specialized work on fuel and lubricant problems at the Petroleum Laboratory, Du Pont petroleum chemicals are backed by broad Company research facilities, that rank with the most extensive in the world.

PIONEER IN GASOLINE ADDITIVES RESEARCH

FREDERIC BAXTER DOWNING is assistant director of the Jackson Laboratory. He is one of the many Du Pont men who worked on the early development of gasoline additives. Today, he directs the research group working on tetraethyl lead, and other groups engaged in research work on neoprene, fluorine and general organic chemicals.

Before joining the Du Pont Company in 1917, he was a chemist with the Aluminum Company of America and the Champion Fibre Company of Canton, North Carolina.

Mr. Downing graduated from Cornell University in 1916 with a B.S. in chemistry. He is a member of the Society of Automotive Engineers, as well as the American Chemical Society, the American Assn. for the Advancement of Science and the Franklin Institute.

Frederic B. Downing

Reprints of Du Pont Paper on "Antiknock Antagonists" Now Available

Reprints of a paper "Antiknock Antagonists," which appeared in the March 1951 issue of Industrial and Engineering Chemistry, are available through Petroleum Chemicals Division district offices. The paper was prepared by H. K. Livingston of the Du Pont Jackson Laboratory.

In the paper it is stated that the antiknock efficiency of tetraethyl lead and related compounds is decreased by antagonists which limit the utility of the antiknocks and lead to economic waste, unless the nature of the antagonists is recognized and their concentrations in gasoline are reduced to the minimum.

A proposed mechanism of antiknock action shows which compounds will have a harmful effect on the octane number of leaded gasolines and permits prediction of the economic advantage to be expected from their removal. The proposed mechanism also provides a basis for further work leading to an ultimate understanding of the chemical processes involved in the knock phenomenon and in knock suppression by chemical antiknocks.

LITERATURE AVAILABLE

The following is a partial listing of many Du Pont bulletins, reports, technical papers, booklets and other aids available to you. Address requests to your nearest Du Pont Petroleum Chemicals Division District Office.

Antiknock Antagonists—by H. K. Livingston, Jackson Laboratory.

Possible Mechanisms By Which Combustion Chamber Deposits Accumulate and Influence Knock
. . . . . Serial A-2087a

Tank Talk — a 52-page booklet which outlines safe procedure for cleaning gasoline storage tanks. Written for the man who does the cleaning.
. . . . . Serial A-1134

DU PONT
REG. U.S. PAT. OFF.
Better Things for Better Living
. . . through Chemistry

Petroleum Chemicals

E. I. DU PONT DE NEMOURS & COMPANY (INC.)
Petroleum Chemicals Division • Wilmington 98, Delaware

District Offices: New York, N. Y. · Chicago, Ill. · Tulsa, Okla. · Houston, Texas · Los Angeles, Calif.

District Laboratories: Wilmington, Del. · Chicago, Ill. · Tulsa, Okla. · Houston, Texas · El Monte, Calif.

IN CANADA: Canadian Industries Limited — Toronto, Ontario — Montreal, Quebec

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

A-2392

Printed in U. S. A.

REFINER AUTHORS and Other Personalities

Information, formal and otherwise, about the men who write for PETROLEUM REFINER as well as others prominent in the processing industry.

J. B. Arant | F. C. Riesenfeld | Clyde L. Blohm | David Arnett

Blohm and Riesenfeld End Corrosion Series

The current article by Fred C. Riesenfeld and C. L. Blohm, "Corrosion Resistance of Alloys in Amine Gas Treating Systems" on page 107, completes a series of three. The first two installments appeared April, 1950, and February, 1951.

Blohm, a graduate of the California Institute of Technology, B.S. and M.S. in chemical engineering, is assistant manager of Research and Development for The Fluor Corporation, Ltd. Riesenfeld, a native of Austria, joined Fluor in 1944 as a research chemist and is also employed in the Research and Development department.

Riesenfeld, who completed a chemical degree equivalent to the B.S. degree at the University of Vienna, spent several years in France, 1938 to 1941, doing research in biochemistry at the University of Paris. He came to the U. S. in 1941 and joined Harold S. Simons, Inc., N. Y., and worked in the production control and development of organic chemicals.

Following his college graduation, Blohm was employed by Canada Dry Company, Chemical and Research Corporation, American Potash & Chemical Corporation, and Maier Brewing Company in the capacity of chemist and chemical engineer. In 1936 he was active in research on synthetic pharmaceuticals and pharmacology as an employe of Gordon A. Alles, Ph.D. He joined Fluor in 1942.

As a result of the April, 1950, article several small pilot-scale heat exchangers and later commercial-size equipment were constructed. The results of these experiences were reported in the February, 1951, article.

The series has enjoyed wide reader appeal.

Engineer David Arnett Is a Real Seaman Too

David Arnett, whose article on Aramco's Ras Tanura refinery appears on page 141, took out two years during his undergraduate days for sea duty with the merchant marines. Receiving his B.S. degree in chemical engineering at the University of Texas in 1943, he was commissioned in the U. S. Navy and was sent to Princeton and M.I.T. for radar and electronics training. After spending 18 months as an electronics maintenance officer attached to naval air groups, he joined The M. W. Kellogg Company in 1946 to work in its petroleum research laboratory at Jersey City. Holding down one job wasn't enough, so he spent his evenings in night school at Stevens Institute and was awarded his M.S. degree.

Joining the Arabian American Oil Company in 1950, Arnett is presently working as a chemical engineer in the Manufacturing and Supply division in New York, but he is expecting a field assignment in the near future. Perhaps it will be Ras Tanura by the sea. Meanwhile, golf and bowling command his attention in his leisure time.

Instruments Man "Back Home in Texas"

J. B. Arant, author of "Basic Orifice Factors for Heavy Wall Pipe," found on page 139, returned to his native Texas last year when he became an instrument engineer at duPont Company's Sabine River Works in Orange, Texas. His former assignment was in Tulsa as an instrument engineer in the Engineering and Construction section of Stanolind Oil and Gas Company.

On return engagement to PETROLEUM REFINER pages, Arant published his first article here in 1948. Born in El Paso in 1922, he studied at Texas College of Mines and Metallurgy, El Paso, and the University of Texas where he received his B.S. in chemical engineering in 1944. Graduation year he accepted an Eastman offer to work as a chemical production supervisor in their Tennessee electromagnetic separation plant. One year at Oak Ridge and Arant was ready to move back to Texas, this time as a process control engineer at Dow's Freeport plant. He still gets enthusiastic about the "extensive and intensive" training program in process instrumentation, shop and field, to which The Dow Chemical Company assigns all new employes.

Arant is married, fishes a bit, reads a lot, and enjoys collecting phonograph records. He is a member of the ACS, the Instrument Society of America, and a junior member of the AIChE.

Alexander Is NPA Counsel

John G. Alexander was named general counsel for the National Petroleum Association replacing John H. Hollands.

John J. McKetta

W. B. Brooks

University of Texas Prof Guides Students With Solubility Paper

The three authors of "Mutual Solubilities of Light Hydrocarbon-Water Systems" which appears on page 118, were brought together temporarily at the University of Texas by a common interest and goal. Warren B. Brooks, a candidate for a Ph.D., and George B. Gibbs, completing a master's degree, united under the supervision of Dr. John J. McKetta to make an extended study of hydrocarbon-water phase equilibria. Their findings are presented in the article noted.

Brooks, who has previously published hydrocarbon vapor pressure data in this magazine, completed his undergraduate work in chemical engineering at Oklahoma A. & M. in 1944. He is presently doing research in chemical engineering on his doctorate at the University of Texas, where he received his M.S. in 1947. During his stay at Texas, he has done research in the Rubber Reserve Project and been an instructor in the Management Department. Golfing and bridge with his charming wife serve as a respite from a heavy research load.

Gibbs, who became Associate Editor of PETROLEUM REFINER in September, completed his undergraduate work in chemical engineering at the University of Texas in 1946. A short tour of naval duty as an ensign, and two years in research and development with the Dow Chemical Company preceded a civilian tour to Saudi Arabia as a chemical engineer for the Arabian American Oil Company. Returning to do graduate work at Texas in 1950, he wrote his thesis on the mutual solubility of *n*-butane and water, and was awarded the M.S. degree in chemical engineering in August, 1951. For recreation, he places travel and music at the top of his list.

McKetta, a new-comer to this magazine but an old-timer to Texas ACS and AIChE members, has previously published several articles on hydrocarbon-water phase equilibria. A native of Pennsylvania, he completed his undergraduate work in chemical engineering at Tri-State College in 1937. After four years in development and production with Wyandote Chemical Company, he served as director of chemical development with the C. B. Shneible Company until 1942. Four years of graduate work at the University of Michigan won him a Ph.D. degree in chemical engineering. In 1946 he joined the chemical engineering staff of the University of Texas. Dr. McKetta recently completed his term as chairman of the department and was promoted to a full professor.

A family man with three sons, Dr. McKetta frequently gets permission from his wife to attend football games and wrestling matches. His present hobby is landscaping his home in cement. And he does a good job of it, too, if reports from his Austin acquaintances can be accepted at face value.

George B. Gibbs

Down Under Author Contributes Another

From the "land down under," George E. Mapstone, a frequent PETROLEUM REFINER contributor, has submitted the article, "The Vapor Pressure of Gasoline" appearing on page 157. He joined National Oil as lab chemist at the Glen Davis plant in 1941 and is additionally in charge of classes conducted on a part-time basis by the company staff for the Sydney Technical College degree in chemical engineering.

Almost completely isolated by miles of unexplored wilderness, Mrs. Mapstone finds herself 52 miles from the nearest "reasonable shopping center." Two other important members of the family were early termed the "pigeon pair," for reasons of association: Bill and coo ... bill is for papa who says; while the youngsters do nobly with their own cooing, explains Mapstone.

Mapstone is a graduate of Canterbury University College, University of New Zealand and has authored and published more than 40 articles, the majority of which dealt with shale technology.

Native Ohioan Keeps Busy in Lake Charles

E. D. Mattix, a native Ohioan and an avid fisherman, is the author of the article on page 132, "Refinery Control Problems." As regards such problems, his case history technique, employed in the presentation, shows practical methods of solving them. Mattix's work has been in conjunction with oil refining phases for the past 20 years, phases which include operation, instrument maintenance, construction and engineering.

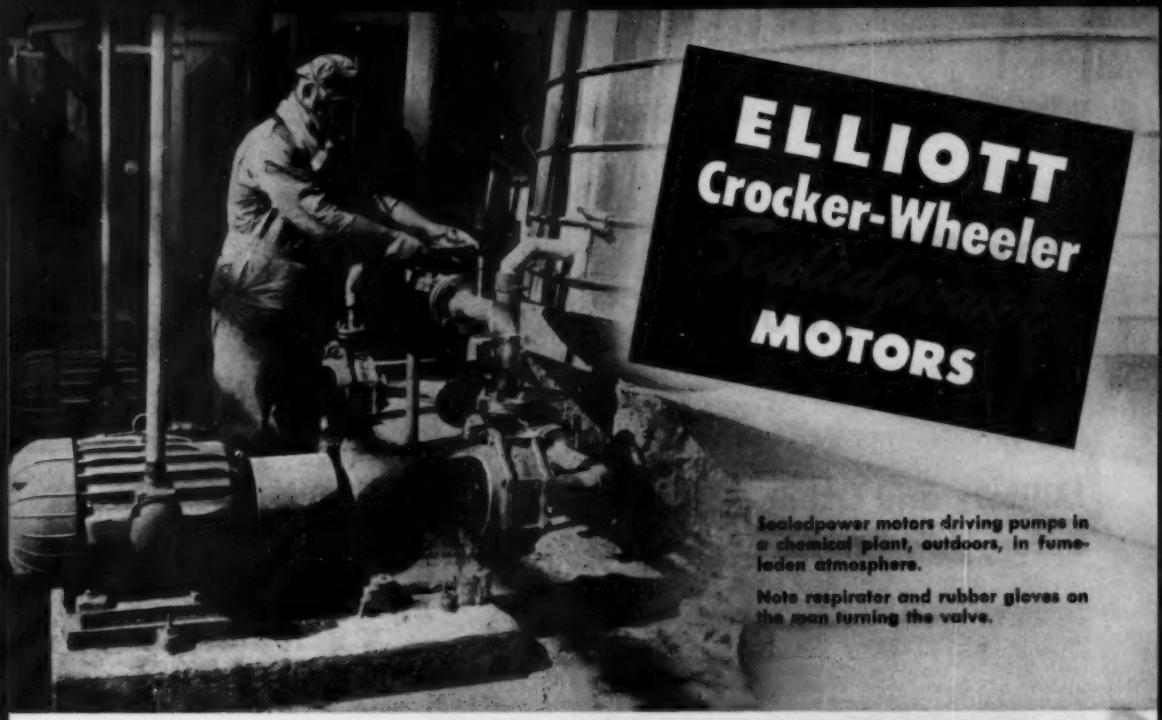
Technical advisor on instruments for Cities Service Refining Corporation at Lake Charles, La., Mattix finds himself in good territory to indulge in his favorite hobbies of hunting and fishing. He also includes photography and instruments among his interests.

A previous article by him, "Notes on the Control of Light Hydrocarbon Fractionators Subject to Variation in Feed Composition and Quantity" appeared in the PETROLEUM REFINER dated September, 1947.

Katz Heads Department At Michigan University

Donald L. Katz, professor of chemical engineering, has been appointed by the University of Michigan board of regents to the chairmanship of the Department of Chemical and Metallurgical Engineering. He succeeds George Granger Brown, who has been appointed dean of the College of Engineering. Katz, sometime PETROLEUM REFINER author, has been on the Michigan faculty since 1936 when he resigned from Phillips Petroleum Company where he spent three years developing a research program in oil and gas production.

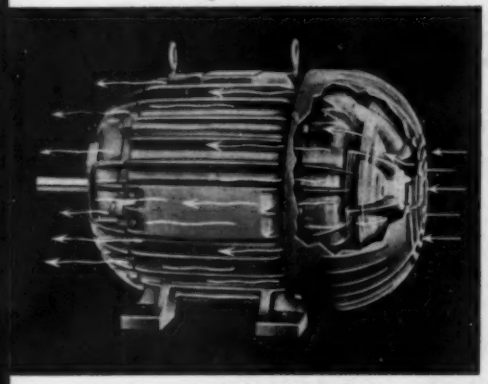
New appointments to the faculty included that of Richard A. Flinn, a research director for American Brake Shoe Company, as associate professor of chemical and metallurgical engineering.



Sealedpower motors driving pumps in a chemical plant, outdoors, in fume-laden atmosphere.

Note respirator and rubber gloves on the man turning the valve.

They live a Tough Life!



The air blast along the finned housing keeps the sealed-power motor cool and clean.

Working under corrosive chemical fumes so powerful that the operator must wear rubber gloves and a respirator . . . exposed at all times to snow, sleet, rain, flying dust, heat and cold—these motors take it all, and like it.

Consider what "Sealedpower" motors save. They need no housing, for they supply their own — weather-proof and fume-proof. They need no special consideration as to location—anywhere will do, indoors or out. They need mighty little care, for these are the famous Crocker-Wheeler Sealedpower motors, totally enclosed, which more than ten years ago brought to industry the advantages of their finned case, self-cooled and self-cleaned by a directed air blast that blows away both heat and dirt. They are today's answer to today's trend toward outdoor installation. Get the facts—write for the Sealedpower bulletin.

HALF CENTURY OF POWER PROGRESS 1901 EC 1951

ELLIOTT COMPANY • *Crocker-Wheeler Division* • *Ampere, N. J.*

PLANTS AT: JEANNETTE, PA. • RIDGWAY, PA. • AMPERE, N. J. • SPRINGFIELD, O. • NEWARK, N. J.

BRANCH OFFICES AND REPRESENTATIVES IN PRINCIPAL CITIES

ELLIOTT *Approved* SERVICE SHOPS COVER THE COUNTRY

CW-34

You're a step ahead with ELLIOTT

The MONTH... in the INDUSTRY

INSPECT SHELL PLANT—Collected around a corner table at Shell Chemical's Torrance, Calif., plant cafeteria for breakfast one day last month were (l-r) Walter Havekorst, president elect of the Long Beach Chamber of Commerce; C. T. Furrer, Standard Oil Company; Martin Voogd, Shell Chemical Corporation; Cliff Beyers and Al Hynes, Shell Oil Company; and D. W. Campbell, general manager of the Long Beach Chamber. Following a short explanation by Manager Voogd of the operation of the Shell plant, a major part of the government's rubber reserve program, the group of 30 committeemen and guests made a tour of the plant.

Military and Other Notables to Speak Before API Groups at Annual Sessions

Chicago, veteran host city for American Petroleum Institute general sessions, will be the scene of the 31st annual meeting to be held November 5 to 8. The annual API meeting usually attracts more than 5000 oil and gas men, industrialists, technicians, business leaders, military and government representatives; men who represent every phase of oil operations.

As in previous years when the meetings have been in Chicago, the Stevens Hotel and the Palmer House will serve as convention headquarters. The Stevens will house all general, group and committee sessions except those of the Division of Transportation. The Transportation headquarters will be at Palmer House and all transportation sessions will be held there.

W. Alton Jones, chairman of the API board of directors and president of Cities Service Company in New York, will preside at both general sessions scheduled at 9:30 a.m. Wednesday and Thursday, November 7 and 8.

Presentation of the 1951 Gold Medal for Distinguished Achievement, which last year was awarded to Walter C. Teagle, will highlight the Wednesday session. The address will be delivered by Oscar L. Chapman, Secretary of the Interior.

Governor Allan Shivers, Texas, and General of the Army Omar N. Bradley, chairman of the Joint Chiefs of Staff, will present the principal addresses at the Thursday morning session.

Among new additions to the 1951 program is a session on fundamental research. There will also be a session on protection of petroleum facilities. The symposium on fundamental research will feature remarks and papers by such outstanding scientists as Dr. Robert E. Wilson, board chairman for Standard Oil Company (Indiana); C. E. ZoBell, of Scripps Institution of Oceanography; F. P. Shepard, Scripps; B. H. Sage, California Institute of Technology; W. L. Whitehead, Massachusetts Institute of Technology, and others.

The session on the protection of petroleum facilities will feature papers by Ned H. Dearborn, president of the National Safety Council, Chicago; Vice Admiral Merlin O'Neill, commandant of the U. S. Coast Guard; and Rear Admiral B. B. Biggs (USN) of the Munitions Board.

The API Board of Directors will meet both morning and afternoon, Tuesday, November 6, and in the afternoon of Wednesday, November 7. The Board of Councillors will meet Tuesday morning, November 6, to nominate candidates for election to the Board of Directors. The report of the Board and the election of directors will take place at the first general session on Wednesday morning, November 7. A new board chairman will be elected to succeed W. Alton Jones, who is now completing the second of the two one-year terms permitted by the Institute's by-laws.

Group and Refining committee sessions (chairmen shown, when name available) include:

Friday, November 2—Subcommittee on Corrosion (All Day), E. Q. Camp, Manufacturers' Subcommittee on Safety and Relief Valves (All Day), L. P. Stillman.

Saturday, November 3—Joint Meeting (All Day), Subcommittees on Field-assembled Pressure Vessels, W. L. Bowler and H. C. Boardman, Subcommittees on Refinery Valves, W. P. Kliment and R. H. Bungay.

Sunday, November 4—Committee on Petroleum Products, A. E. Miller. Subcommittee on Pressure-relieving Systems, J. C. Souder. Automotive Research Committee, John T. McCoy. Subcommittee on Unfired Pressure Vessels, N. J. Rees.

Monday, November 5—Group Session on Fundamental Research, Lloyd E. Elkins. Agricultural Session, E. A. Snyder. Division of Marketing, Harry J. Kennedy. Protection of Petroleum Facilities, W. R. Boyd III. Subcommittees: Mechanical Equipment, E. F. Voss. Centrifugal Pumps, Lynn Sawyer. Electrical Equipment, L. M. Goldsmith. Instruments, G. N. Ehly. Committee on Refinery Equipment, W. H. Creel. Nominating Committee, Division of Refining, C. M. Ridgway.

Tuesday, November 6—Group Sessions on Financial and Accounting, J. R. Mulvey. Interdivisional Symposium, R. E. Wescott. Division of Marketing, Harry J. Kennedy. Division of Transportation, J. H. Peper. Division of Production, W. L. McCloy, Jr. American Petroleum Industries Committee, Oscar John Dorwin. Lubrication Session. Board of Directors, Board of Councillors. Program Committee, Division of Refining, W. M. Holaday. Advisory Committee, Division of Refining, C. E. Davis. General Committee, Division of Refining, W. L. Stewart, Jr.

Wednesday, November 7—General Session, W. Alton Jones. Group Sessions: Division of Production, R. O. Garrett. Division of Refining, W. L. Stewart, Jr. Division of Transportation, T. E. Swigart. Board of Directors.

Thursday, November 8—General Session, W. Alton Jones. Executive Committee.

The following Non-divisional Committees are of special interest to refiners:

Friday, November 2—Committee on Underground Gasoline-Storage Tanks, J. Howard Myers. Committee on Storage-Tank Venting, O. W. Johnson. Committee on Tank Cleaning, E. K. Locher.

Saturday, November 3—Code 15 Subgroup on Tests for BS&W, P. L. DeVerter.

Sunday, November 4—Code 25 Subgroup on Tank Measurement and Calibration, Bowman Brannon. Committee on Liquefied Petroleum Gas, E. H. Barlow.

API Refining Meeting on Pacific Coast, May 12

The 17 midyear meeting of the Division of Refining of the American Petroleum Institute will be held in San Francisco, May 12-15, 1952, according to W. L. Stewart, Jr., vice president of that API division. This is the first refining meeting to be held on the Pacific Coast. A technical program is being planned under the chairmanship of W. M. Holaday, director of Socony-Vacuum Laboratories, N. Y. Offers on basic refinery subjects will be approved the first week in November by the following committees:

Corrosion and Corrosion Prevention: E. Q. Camp, Humble Oil & Refining Company, Box 3538, Baytown, Texas. Electrical Equipment: L. M. Goldsmith, The Atlantic Refining Company, 260 South Broad Street, Philadelphia. Analytical Research: E. L. Baldeschwieler, Standard Oil Development Company, P. O. Box 51, Linden, N. J. Waste Disposal: L. Mittelman, Tide Water Associated Oil Company, 79 New Montgomery Street, San Francisco.

Training Personnel: T. M. Rushing, The Texas Company, 135 East 42 Street, New York. Automotive Fuels and Lubricants: T. B. Rendel, Shell Oil Company, 50 West 50 Street, New York 20. New Refining Processes: W. T. Gunn, API, 50 West 50 Street, New York.

Special Santa Fe Trains Set Up for API Meeting

Several hundred Texas oil industry representatives attending the American

STEEL and oil have become as closely related as the chicken and the egg. Any sizable increase in steel production calls for a like increase in oil producing and refining capacity. More steel means more machines, ships, locomotives, trucks, planes and a myriad of other steel products that need fuels and lubricants. And that will take more steel to drill wells and to build pipe lines and refineries.

New steel plants and refineries are both "first" at McKee—and both in a hurry. McKee maintains separate divisions for iron and steel plant and petroleum refinery design, engineering and construction. The combined technical knowledge and experience of these two divisions are particularly advantageous to McKee clients in the present expansion program.

DESIGN, ENGINEERING AND CONSTRUCTION FOR THE PETROLEUM REFINING AND IRON AND STEEL INDUSTRIES

McKee Engineering

Arthur G. McKee & Company · Established 1905

Headquarters: McKee Building, 2300 Chester Avenue, Cleveland 1, Ohio. *New York:* 30 Rockefeller Plaza, New York 20, N.Y. *Tulsa:* 918 First National Bank Building, Tulsa 3, Okla. *England:* The Iron and Steel Division of Arthur G. McKee & Company, is represented by Head, Wrightson & Co., Ltd.

The MONTH...

Petroleum Institute's annual meeting at Chicago, November 5-8, will travel on a special Santa Fe train. This 18-car train will leave Houston at 7 p.m. November 3 and arrive in Chicago at 8 p.m. November 4. Returning it will leave Chicago at 3 p.m. November 8 and reach Houston at 4 p.m. November 9.

Another special Santa Fe streamliner has been scheduled out of Tulsa at 5 p.m. November 4 and will arrive in Chicago at 8 a.m. November 5. On the return trip, the special will leave at 4:30 p.m. November 8, arriving at Tulsa 7:30 a.m. November 9.

PAD Predicts 47 Percent Cut for Tetraethyl Gas

Forecast of a drastic cut in anti-knock quality of automobile gas for civilian use unless additional supplies of metallic lead are made available to tetraethyl lead manufacturers was made by C. E. Davis, director of refining for the Petroleum Administration for Defense. He said the amount of tetraethyl lead available for motor gas may be cut 47 percent below August levels as a result of government allocation of lead.

Union Carbide Appoints Eversole Research Head

Union Carbide and Carbon Corporation has appointed Dr. James F. Eversole manager of research administration. He will help coordinate the research activities of all the Corporation laboratories where basic research and development work is being done on alloys, chemicals, gases, carbons, and plastics. Dr. Eversole joined the company as a research chemist in 1929.

Survey Reveals 38 Percent Jump in 1951 Spending

In spite of gloomy government forecasts of crippling steel pipe and equipment shortages, the oil industry is expanding with a rush which will probably raise 1951 expenditures over the $3 billion mark for the first time. A survey of 20 major companies by the *Wall Street Journal* revealed that financial outlays in 1951 are 38 percent greater than those for 1950.

Sun Oil Company exceeded its 1950 expenditure of $31 million by $14 million. Phillips Petroleum Company, with a 1951 expansion cost of $140 million, compares with $92 million for 1950. Standard Oil Company (Indiana) estimates its 1951 capital expenditures at $190 million to compare with $127 million last year.

Cities Service Oil Company is jumping to nearly $89 million from the $66 million spent in 1950. The Standard Oil Company of Ohio has increased its 1950 cost of $30 million by $10 million. Union Oil Company of California is doubling its expenditures this year to reach a total of $66.5 million. Standard Oil Company of California spent $35 million on its Perth Amboy refinery, $10,254,000 at its El Paso plant, and next month will launch a $6 million super-tanker.

On the basis of the 20 companies surveyed, 57 percent of expenditure went to producing phases; 18 percent to refining; nine percent to transportation; and 4 percent to other phases of production.

Gulf Names Safety Man

An employe of Gulf Oil Corporation since 1928, Clarence E. Booz, Jr., recently was appointed head of the safety unit of the employe relations department. He will be respoisible, on a staff advisory basis, for company-wide planning, promoting, coordinating and reviewing of safety and accident prevention programs and will make his headquarters in Pittsburgh.

Additive Prevents Clogging

A new fuel oil additive which virtually eliminates filter screen clogging in domestic fuel oil burners is being marketed by Shell Chemical Corporation. In diesels, Ionad 17, the new product, will reduce maintenance costs due to clogged screens and fouled fuel-injector parts. Long experimenting plus extensive field tests preceded the marketing, Shell officials said.

Trends of Operations and Changes in Stocks

Figures on crude stocks are from Bureau of Mines weekly reports; all others from American Petroleum Institute weekly reports, which are estimates on Bureau of Mines basis.

(All figures in thousands of barrels—add 000)

Trends in Week Ended	Crude Oil			Gasoline		Gasoil and Distillate		Residual Fuel	
	Production Daily	Runs to Stills Daily	Stocks Week End	Production Weekly	Stocks Week End	Production Weekly	Stocks Week End	Production Weekly	Stocks Week End
1950:									
January 28	4,956	5,470	248,411	18,363	124,270	7,302	66,337	8,389	57,036
February 25	5,000	5,277	245,586	17,703	133,888	6,890	56,056	7,855	48,663
March 25	4,848	5,469	244,227	17,839	135,406	6,870	40,577	8,171	42,546
April 29	5,014	5,314	244,744	18,038	128,655	6,531	36,686	7,272	39,260
May 27	5,118	5,591	240,842	18,704	122,757	7,201	40,607	7,421	39,308
June 24	5,355	5,636	240,762	19,626	115,036	6,868	50,580	7,461	41,291
July 29	5,522	5,870	240,236	19,981	109,076	7,266	61,437	7,870	42,253
August 26	5,699	6,197	236,934	20,263	105,793	7,559	65,841	8,343	41,697
September 30	5,903	6,051	241,631	19,624	104,383	8,460	76,734	8,306	42,330
October 28	5,895	6,051	244,805	19,878	105,062	8,259	84,057	8,449	44,310
November 25	5,888	6,238	244,497	19,847	106,424	8,591	86,768	8,470	45,566
December 23	5,763	6,159	250,799	20,075	112,631	9,436	73,273	8,715	39,914
1951:									
January 27	6,066	6,483	244,230	21,106	126,261	9,954	58,997	9,906	40,378
February 24	5,954	6,524	237,204	20,815	136,870	10,545	48,764	9,471	38,995
March 31	6,041	6,381	235,956	20,398	142,186	9,365	43,170	9,147	37,282
April 28	6,154	6,236	242,479	19,876	137,474	8,061	43,859	8,747	36,080
May 26	6,163	6,430	246,400	21,102	130,819	8,580	51,344	9,045	37,365
June 30	6,181	6,595	247,299	21,066	126,844	8,542	65,700	9,036	41,097
July 28	6,205	6,396	251,203	21,539	121,156	8,174	76,938	8,858	44,957
August 25	6,220	6,500	252,257	21,592	115,934	8,761	85,543	8,763	46,753
September 29	6,303	6,558	252,569*	21,085	112,356	9,124	97,019	8,332	47,589

* Stocks September 22.

B-A Directors Appoint Secretary and Treasurer

H. T. O'Neill, recently appointed treasurer of The British American Oil Company Ltd., and Robert Donellan,

O'Neill

Donellan

new company secretary, will continue their present offices of vice presidents of finance and comptroller respectively. O'Neill joined British American in 1949 after serving many years with The Royal Bank of Canada. Donellan came to British American in 1930 and has been comptroller for the past six years.

AIOC Consults Australian Government on Refinery

Anglo Iranian technicians have arrived in Sydney, Australia, to consult with personnel of the Commonwealth Oil Refineries concerning a refinery which the two companies will build jointly. The refinery is estimated to cost between $66 to $86 million and will be designed to process approximately 72,000 barrels of crude daily. While the site of the plant is undecided, land adjacent to Commonwealth's Victoria refinery is being considered.

Overseas Company Formed

Socony-Vacuum Overseas Supply Company, a new subsidiary of Socony-Vacuum Oil Company, Inc., has signed a lease for office space at 158 Linwood Plaza, Fort Lee, N. J.

The new company was organized to centralize handling of Eastern Hemisphere operations which are now divided among various departments of the parent company. Robert Siegel has been named president of the new company.

E. H. Blum Retires

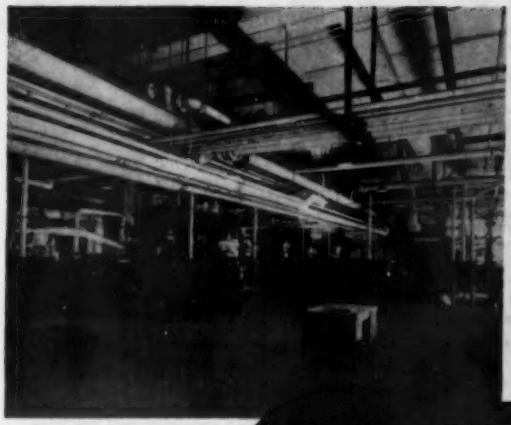
E. H. Blum, vice president and director of The Atlantic Refining Company and general manager of the company's crude oil production department, retired early this month. Blum, a resident of Dallas, joined Atlantic at Philadelphia in 1905. In 1936 he was elected a vice president, and became the director in 1937.

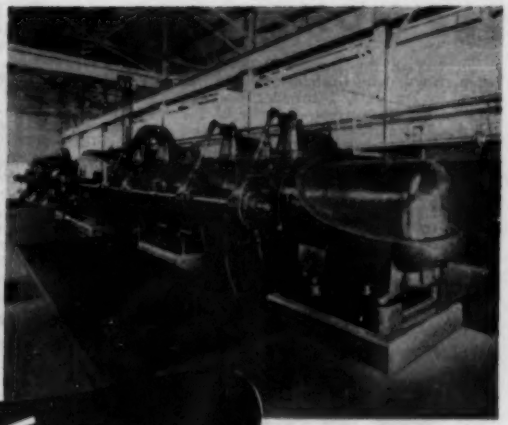
Dr. Fitterer Now Dean

Dr. G. R. Fitterer, appointed dean of the Schools of Engineering and Mines at the University of Pittsburgh effective with the Fall term, had been head of the Department of Metallurgical Engineering since 1939. He holds a doctorate from the University of Pittsburgh.

Boyd Tenders Resignation; Schroeder Likely Nominee

Dr. James Boyd reportedly becomes vice president of Kennecott Copper Company when final action on his resignation





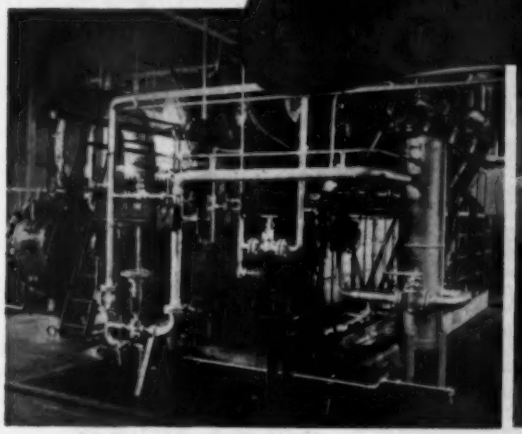
The Pure Oil Company. A group of Cooper-Bessemer 4-cylinder, 400 hp GMV's, now going on 8 years of service in Pure Oil's Toledo refinery.

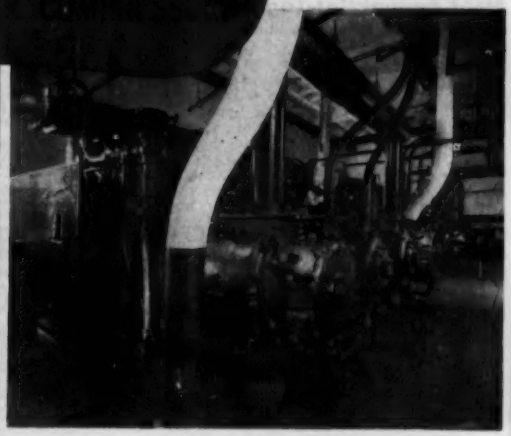
Humble Oil & Refining Company. Installed back in 1936, these two Cooper-Bessemer Type 36 horizontal gas engines drive hot oil pumps.

A Top Team through the years...

The Texas Company. One of six modern Cooper-Bessemer V-angles, 1000 hp GMV's in refinery service at this company's Eagles Point refinery, Westville, N. J. A duplicate plant has just been completed at Lawrenceville, Ill.

Continental Oil Company. View shows 600 hp GMV-6 and 800 hp GMV-8 handling air, recycle gas and propane in Continental's Ponca City, Oklahoma plant.





The Cooper-Bessemer Corporation

MOUNT VERNON, OHIO — GROVE CITY, PENNA.

New York, N. Y. Washington, D. C. Bradford, Penna. Parkersburg, W. Va.
San Francisco, Calif. Houston, Dallas, Greggton, Pampa and
Odessa, Texas Seattle, Wash. Tulsa, Okla. Shreveport, La.
St. Louis, Mo. Los Angeles, Calif. Chicago, Illinois Caracas, Venezuela

The MONTH...

as director of the Bureau of Mines is taken. Boyd, who probably will be replaced by Dr. W. C. Schroeder, resigned as a result of growing disfavor of the Interior Department because he opposed plans to launch a government-subsidized program for the production of synthetic liquid fuels.

Dr. Schroeder was recently made an assistant director of the Bureau, an appointment which was interpreted as the first step toward placing Dr. Schroeder in the director's chair. Secretary of the Interior Chapman reportedly has said that Schroeder is not his candidate to replace Boyd.

Christner New Head of Mineral Wool Institute

G. J. Christner of The Eagle-Picher Sales Company, Cincinnati, was elected president and chairman of the board of the Industrial Mineral Wool Institute at its tenth annual meeting last month at Hot Springs, Va.

H. W. Elkins, Owens-Corning Fiberglas Corporation of Toledo, was elected vice-president, and Frank Christenson, Refractory & Insulation Corporation of New York, was named treasurer. New directors are Elkins, E. R. Stevens of Baldwin-Hill Company, R. E. Daniels of The Federal Portland Cement Company and N. L. Morell of N. L. Morell.

Standard (Ohio) Veterans Hold Annual Get-Together

The annual reunion of employes who have served The Standard Oil Company (Ohio) for 25 years or more was held at the Biltmore Hotel in Dayton early this month. One of the petroleum industries most unusual clubs, the Sohio Quarter Century Club now numbers more than 700 active service employes and more than 400 annuitants.

George Baer, retired, holds a record of 69 years with the company. The ranking active member of the club is James A. Rankin, Toledo refinery, with 48 years active service.

Texas City Research Lab Planned by Pan American

Bids on a chemical engineering and research laboratory building addition, and other administrative facilities for it's Texas City plant will be taken this month by Pan-American Refining Corporation as they resume a $2 million program which was first announced two years ago. Pan-American has a $3.5 million refinery expansion currently under construction.

Munitions Board Head Asks Refining Capacity Increase

U. S. refining capacity must be increased as fast as possible both in amount and flexibility, reported Rear Admiral B. B. Biggs when he spoke to the National Petroleum Association recently. He suggested that 1 million barrels-a-day currently scheduled, is not enough by mere fact of the industry's inability to complete plants in step with the rise in the demand curve.

Biggs, chairman of the Munitions Board Joint Petroleum Committee, said new refineries must have a maximum degree of flexibility to fill avgas requirements and to meet any wartime demand for residual fuel oil. He expressed doubt that present yield ranges are wide enough to take the shock of an all-out emergency and called for additional units to increase the range of products for existing plants.

Aviation gasoline facilities will not grow obsolete because of the shift to jet aircraft, he promised, and added that the Navy and Army Air Force "are willing to bet $85 million that it won't happen for five years." (The military has expressed willingness to enter alkylate purchase contracts of that duration.)

NGAA Changes Amarillo Date to November 20

The Panhandle-Plains regional meeting of the Natural Gasoline Association of America has been changed from December 7 to November 20 at the Herring Hotel, Amarillo, Texas, according to John Kindle, Lone Star Producing Company of Dallas, chairman of the program committee. Room reservations at the hotel are being moved up automatically.

THE OIL MAN'S CALENDAR

OCT.	
8–12	National Safety Council, 39th National Safety Congress and Exposition, Chicago. Stevens Hotel.
14–20	Oil Progress Week.
15–17	American Gas Association, Annual. St. Louis, Kiel Auditorium.
15–19	National Metal Congress & Exposition, Detroit, Mich.
18–20	National Association of Corrosion Engineers, South Central Region. Corpus Christi, Texas.
19	NGAA, Pedional, Tyler, Texas, Blackstone Hotel.
22–24	American Standards Assn., Annual. New York, Waldorf-Astoria Hotel.
29–31	National Lubricating Grease Institute, Annual. Chicago, Edgewater Beach Hotel.
31 to Nov. 1	National Transportation Meeting, Chicago, Knickerbocker Hotel.
NOV.	
3– 8	Oil Industry Information Committee, Chicago, Stevens Hotel.
5– 8	American Petroleum Institute, Annual Convention, Chicago, Stevens Hotel.
20	NGAA Regional, Amarillo, Herring Hotel.
22–23	Independent Petroleum Assoc. of America, Annual, Houston, Shamrock Hotel.
25–30	American Society Mechanical Engineers, Annual Meet, Atlantic City, Chalfonte-Haddon Hall.
26 to Dec. 1	Exposition of Chemical Industries, New York, Grand Central Palace.
DEC.	
2– 5	American Institute Chemical Engineers, Atlantic City, Chalfonte-Haddon Hall.
26–31	American Assn. for the Advancement of Science, Annual, Philadelphia, The Bellvue-Stratford.
JAN., 1952	
14–17	Plant Maintenance Show, Philadelphia, Convention Hall.
14–18	Society of Automotive Engineers, Inc., Annual, Detroit, Hotel Book-Cadillac.
MAR.	
3– 7	ASTM, Spring and Committee Meeting, Cleveland, Ohio, Hotel Statler.
11–14	Natl. Assn. of Corrosion Engineers, Annual Conference and Exhibition, Galveston, Galvez Hotel.
16–19	AIChE, Regional, Atlanta, Biltmore Hotel.
31- Apr.1-2	WPRA, 40 Annual, San Antonio, The Plaza Hotel.

Continental Promotes Cobb To New Training Director

M. L. Cobb, superintendent of the lubricating oil division in Continental Oil Company's Ponca City, Okla., refinery, has been promoted to the newly created position of director of training for the company's manufacturing department.

Cobb

Cobb, a graduate of Oklahoma A. & M. College, joined Continental in 1925. His entire tenure with the company has been at Ponca City. In 1940 he was named superintendent of the power division, and subsequently foreman of the solvent treating unit, general foreman of the lubricating division and superintendent last June.

PAD Shifts Personnel of Refining, Materials Units

Rolland P. Wood has been named chief of PAD's Refining Materials Branch, Materials Division, with Lawrence V. Shaughnessy succeeding him as chief of Marketing Materials Branch. The appointments were announced after Roy P. Wilson, former Refining Materials chief, was moved to the Refining Division as chief of Refining Projects Branch.

Two more PAD appointees are Richard M. Morrison, Texaco, and R. P. Walsh, Commonwealth Gas Corporation. Morrison became director of PAD Materials Division, succeeding Frank Watts, Humble. Walsh succeeds Charles Webber, Sun Oil, as director of the Natural Gas Production and Processing Division.

National Research Names Vaughan Process Director

National Research Corporation has appointed James L. Vaughan director of the process engineering department. Vaughan holds S.B. and S.M. degrees in chemical engineering from the Massachusetts Institute of Technology. He has been employed by Standard Oil Company (New Jersey), by Shell Chemical Corporation as chief technologist at their Dominguez and Martinez plants, and Rhode Island State College at Kingston as assistant professor of chemical engineering. Since 1947 he has been a design and development engineer for Rohm & Haas Company in Philadelphia.

ISA Elects Executive Panel at Houston Exhibit

National officers for the Instrument Society of America were elected at the sixth annual conference and exhibition held in Houston last month.

Dr. Arnold O. Beckman was elected president; David M. Boyd, Jr., and Robert T. Sheen, vice presidents. Still incumbent are W. A. Wildhack, first vice president; N. L. Isenhour, vice president; G. R. Feeley, treasurer; and Richard Rimbach, secretary.

The Society's Exhibition drew 7000 instrument engineers, mechanics, manu-

KOCH OFFERS YOU

This Brochure of the NEW

"BENTURI"-TYPE KASKADE FRACTIONATING TRAY

— which has been acclaimed thruout the process industry as *the successor to the bubble tray.*

You will be interested in this brochure telling how and why consistently higher capacities and efficiencies are obtainable.

MAIL TODAY

KOCH ENGINEERING CO., INC.
321 WEST DOUGLAS AVE.
WICHITA 2, KANSAS

Gentlemen:

Please send us your Brochure No. 629 on the new Koch "Benturi"-type Kaskade tray.

Name _____

Company _____

Address _____

City _____ *State* _____

DUO-STEP Leverage

It's startling news when a steam trap manufacturer suggests that you're using *too many* steam traps.

But if it takes *two* ordinary traps to do a job that can be done with *one* Clark Duo-Step, it's obviously a waste of money.

Clark Duo-Step Leverage actually gives *double the drainage capacity* of old-fashioned traps. This saves you money three ways: (1) in original trap cost, (2) installation and (3) maintenance.

Ask your Clark representative for an eye-opener demonstration of Duo-Step on your own steam lines . . . or write us for additional information.

Here's how DUO-STEP doubles drainage capacity

THE CLARK MANUFACTURING COMPANY
1847 East 38th St. • Cleveland 14, Ohio

Clark
THE HOME OF DUO STEP LEVERAGE

The complete line of dependable fluid controls

The MONTH...

facturers and suppliers to the Houston meeting.

Plants manufacturing industrial instruments have grown from 68 in 1939 to 500 today according to the Bureau of Census. Automatic control instruments have assumed a big job in controlling factory processing operations and freeing technical manpower for more creative assignments.

Metallurgical Consultant Opens Houston Office

M. E. Holmberg, Southwestern metallurgist, opened a Consulting Engineer office in the Bermac Building, 4101 San Jacinto, in Houston.

Holmberg

He had been associated with Phillips Petroleum Company for the past 15 years and spent ten years with that company as manager of Phillips Test Division at Bartlesville, Okla.

After graduation in Metallurgical Engineering at Pennsylvania State College in 1931, Holmberg was employed by the Aluminum Company of America. In 1932 he transferred to Black, Sivalls and Bryson, Inc., as metallurgical and welding engineer. Several technical journals have published scientific articles written by him.

Recent Chemical Graduates Added to Personnel by SOD

Four men have been added to the Shell Oil Development Company and a fifth man is studying recent developments in the field of microchemical analysis at New York University.

Richard D. Mullineaux, recent Ph.D. graduate in organic chemistry at the University of Wisconsin, is a new member of the staff. Ross E. Van Dyke, formerly an instructor in chemistry at Hopkins University, is working for SOD in the colloid chemistry field. Van Dyke, a Ph.D. graduate in chemistry of Brown University, was connected with the Manhattan project during World War I.

John A. Buckland, recent Ph.D. graduate in chemical engineering of Pennsylvania State College, and Howland A. Larsen, an M.S. graduate in chemical engineering from the University of Illinois, are also new additions to the company personnel.

A. B. Bullock, employed by SOD at Emeryville, is currently at New York University. He will return to the laboratory early in 1952 to assume charge of microanalytical work. A graduate of the University of California, he has been with the company since 1936.

Two Million Hour Safety Mark Set at Ponca City

Continental Oil Company's Ponca City, Okla., refinery, with a personnel numbering 1500 employes, has completed two million man-hours without a lost time injury.

Continental's Lake Charles, La., refinery reached its first one million man-

"RUGGED"

Corrosion, vibration and abrasion—the wrecking crew of piping systems—are stopped cold by *ESCO* engineered piping. Here's why:

Stainless Steel for Corrosion Resistance

ESCO pipe is centrifugally cast of corrosion resisting stainless steels. Pipes are joined with fittings cast of the same stainless analyses and designed for the individual layout. Pipe and fittings are flanged or welded together, heat treated to assure maximum effectiveness in resisting corrosion, and then pressure tested.

Wall Thicknesses as Desired

Wall section of *ESCO Spuncast* piping is controlled by the amount of molten metal introduced into the centrifugal mold. Hence walls can be of any required thickness to withstand high pressure or vibration.

ESCO Spuncast Piping is cast in the standard stainless analyses, and in sizes ranging from 2" to 16". Fittings are available in flanged and welding types of the same analysis.

Here's the secret: *Uniform, homogenous grain structure of ESCO Spuncast pipe offers effective, long-time resistance to corrosion, vibration and pressure.*

Your nearest *ESCO* office will gladly give you detailed information about engineered piping systems; or fill in and mail the coupon for information about the manufacture and advantages of *ESCO Spuncast* stainless steel pipe and other equipment for the refinery.

ESCO STAINLESS AND HIGH ALLOY STEELS

ELECTRIC STEEL FOUNDRY

2181 N. W. 25th Avenue, Portland 10, Oregon

Sales Offices and Warehouses

CHICAGO, ILLINOIS — NEW YORK CITY, NEW YORK
HONOLULU, T. H. — SAN FRANCISCO, CALIFORNIA
HOUSTON, TEXAS — SEATTLE, WASHINGTON
LOS ANGELES, CALIFORNIA — SPOKANE, WASHINGTON
EUGENE, OREGON — MEDFORD, OREGON

IN CANADA — *ESCO* LIMITED, VANCOUVER, B. C.

ESCO Spuncast FOR ULTIMATE ECONOMY

ELECTRIC STEEL FOUNDRY
2181 N. W. 25th Avenue, Portland 10, Oregon

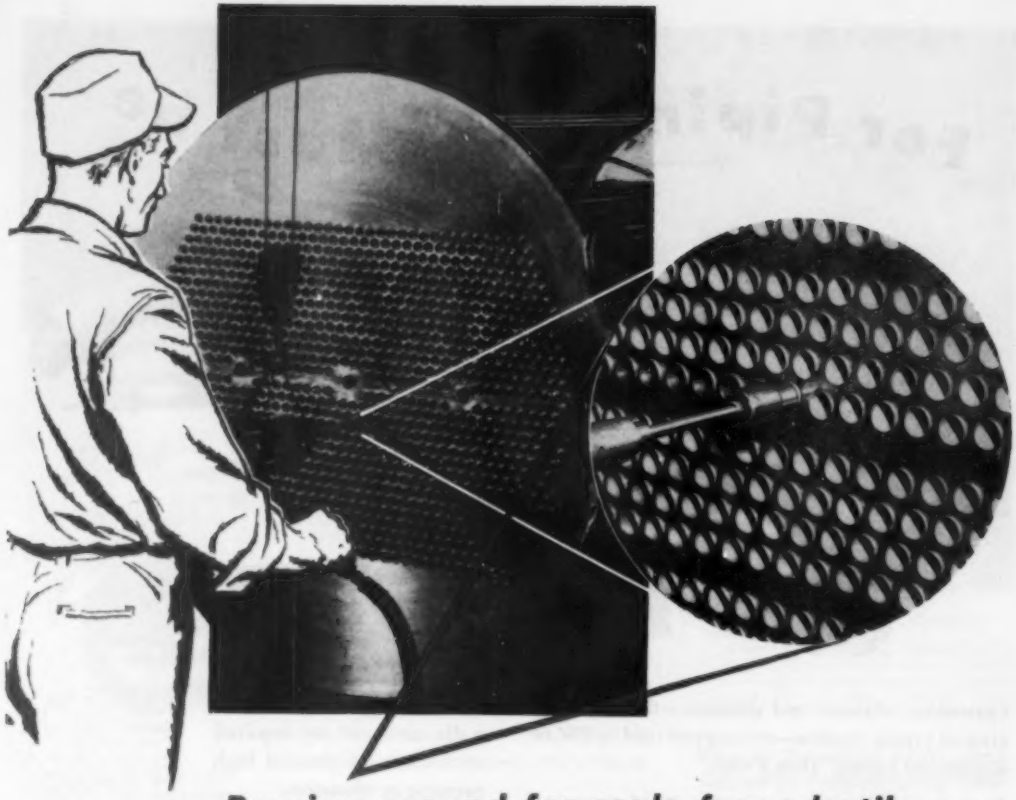
Please send me information on ESCO Spuncast Pipe.

Name_____

Company_____

Address_____

City_____ Zone_____ State_____



Proving ground for scale-free, ductile

ELECTRUNITE HEAT EXCHANGER TUBES

Right here, between the roller and the tube sheet, the men who roll-in tubes first notice the advantages of ELECTRUNITE Heat Exchanger Tubes...

They expand easier, faster, smoother . . . the fully-normalized structure of ELECTRUNITE Tubes provides easy-rolling ductility that's uniformly predictable.

You'll notice the advantages, too . . . in longer life between retubings, in lower cost per year, in less time off-stream for repairs. ELECTRUNITE Tubes are made in a wide range of sizes and gages, in carbon and stainless steel analyses. For complete data, write

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION
224 EAST 131st STREET • CLEVELAND 8, OHIO

REPUBLIC STEEL

ELECTRUNITE

STAINLESS STEEL TUBING AND PIPE

The MONTH...

hour mark without a lost time injury in June and is now working toward the two-million goal.

In the past 17 years Continental has won 33 first-place departmental awards in the petroleum section of the National Safety Council's annual contests.

Henderson Will Handle Company's Canadian Work

Catalytic Construction Company, Philadelphia, has appointed Gordon R. Henderson, chief engineer of Polymer Corporation at Sarnia, Ontario, as general manager of its Canadian activities. His headquarters will be in Sarnia.

Henderson

Henderson received a B.S. degree with honors in civil engineering from Queen's University at Kingston, Ontario, and then served a two-year student apprenticeship with the Ontario Hydro-Electric Power Commission. In 1932 he joined the Shell Oil Company at Montreal and in 1940 took charge of construction of the $18 million Shell refinery at Heysham Lanes, England.

Crude Supply Sufficient But Avgas In Short Supply

The Petroleum Administration for Defense is slated to start inquiry regarding production of crude and refinery operations levels. Reportedly the Iranian shutdown has been so completely overcome that the U. S., through the balance of 1951, will be required to contribute only 260,000 barrels daily towards making up the world deficit as compared with a 460,000 barrels that had been anticipated.

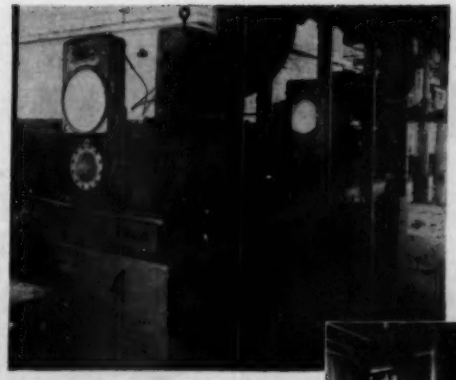
However, PAD will probably tell the Texas Railroad Commission and other state bodies that crude allowables should be maintained at present levels during the remainder of the year. It is believed that even though stocks of crude or products rise in October and November, requirements in 1952 will justify such a build up. The only serious problem remaining as a result of the Iran shutdown is that of aviation gasoline. U. S. military demands have piled heavy requirements on American industry that only drastic measures can fulfill. A new series of orders to industry is expected soon.

Standard California Gives Management Promotions

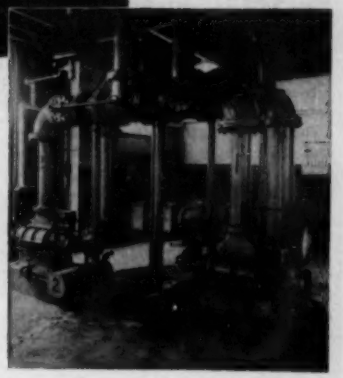
Management personnel changes within its manufacturing department were effective this month at Standard Oil Company of California refineries.

J. T. Higgins, formerly assistant manager of the operations control division in San Francisco, became manager of operations at the Richmond, Calif., refinery. J. A. Hapke, formerly superintendent of the light oil division at El Segundo refinery, is now manager of the service divisions at that plant.

C. D. Lewis, asistant superintendent



The four meters illustrated are part of a total installation of nine R-C Meters in a large processing plant. These units measure acetylene gas sold to nearby manufacturers, who also use R-C Meters at the receiving ends. Capacities range from 3,000 cfh to 130,000 cfh.



YOU CAN ALWAYS

trust

R-C METERS

If you're measuring gas for production processes, you can't take any chances on quantities. If you are buying or selling it, you need cash register accuracy. You want equal precision for departmental cost accounting.

The permanent accuracy of R-C Positive Displacement Meters has long been proved for all these purposes by manufacturers and utilities which buy, sell and use gas. Four important reasons account for this unvarying reliability:

1. Accuracy is not affected by variations in specific gravity, rate of flow, pulsation, moisture, impurities or uncontrollable factors.
2. Accuracy is not subject to adjustment of meter or recorder by operators or other persons.
3. Accuracy is not affected by reasonable overloads.
4. Accuracy is permanent because measuring chambers are surrounded by precision-machined, cast-iron surfaces.

The 31 standard sizes of R-C Meters give capacities from 4,000 cfh to 1,000,000 cfh. They are extremely compact, permitting installation in cramped spaces. Indicating and recording instruments are available for all types. For whatever purposes you measure gas, you can permanently depend on R-C Meters. Ask for Bulletin 40-B-14 or write us your specific problem.

ROOTS-CONNERSVILLE BLOWER CORPORATION
510 Crescent Avenue, Connersville, Indiana

ROOTS-CONNERSVILLE

BLOWER BUILDERS SINCE 1854

ONE OF THE DRESSER INDUSTRIES

For Better MIXING at Lower cost

It's no accident that INTERNATIONAL MIXERS are steadily gaining in favor throughout the petroleum industry.

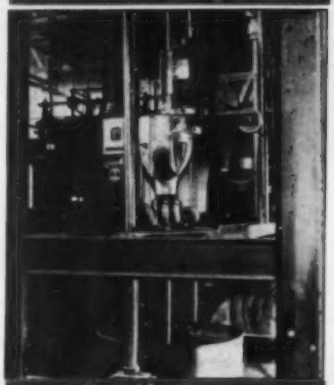
In step with today's fast moving developments, this Company has maintained a continuous Laboratory, Engineering and Research program to improve the theory and practice of mixing. This research is immediately published and made available to the industry in improved models and designs. INTERNATIONAL also maintains a customers' service Laboratory for test runs on your product. Results are of course, safeguarded against exploitation by others, and cost free.

INTERNATIONAL Representatives are located in principal cities in the U. S. and throughout the world. These sales and service representatives are always available should service be necessary, and are right behind the INTERNATIONAL Performance and Workmanship Guarantee.

It costs nothing to find out how the INTERNATIONAL organization can help you with your mixing problems—Send for catalog and full information.

INTERNATIONAL ENGINEERING, Inc.
DAYTON 1, OHIO
NEW YORK—17 Park Row
CHICAGO—407 S. Dearborn St.

Side Entering Agitators



Portable Mixers

Top Entering Agitators

International Mixing Equipment

SEND FOR YOUR COPY TODAY

Informative Literature on Request—No obligation

The MONTH...

of the package and utilities division at El Segundo, was named superintendent of the light oil division at the same refinery. M. F. Miller, until recently manager of construction at California Refining Company's Barber, N. J., refinery, has taken over the position of assistant manager of the operations control division at Standard's San Francisco offices.

C. A. Pollard has been named general manager, El Segundo refinery succeeding E. E. Lyder who is retiring after 26 years service. Pollard has been assistant general manager of the Richmond refinery since 1940, first joined the company in 1916.

Pollard

C. W. Rehfuss, formerly manager of operations, will succeed Pollard at Richmond. He has been with the company since 1924 when he was graduated from Stanford.

Other changes include the promotion of P. N. Johnson to assistant superintendent of the package and utility division from superintendent of organization and cost control and C. D. Barker from foreman light oil division to superintendent of organization and cost control.

Shell Appoints Maas To Palembang, Sumatra

Leaving General Petroleum Corporation where he has been employed since 1934, Randal Maas of Palos Verdes, Calif., has accepted a position as assistant manager of Standard-Vacuum Petroleum Maatschappij's refinery at Palembang, Sumatra, in the Republic of Indonesia.

Maas will visit Holland briefly to visit the SVPM office for orientation. A graduate of the California Institute of Technology and the University of Southern California, Maas has been employed by GPC as laboratory technician, chemist, gas engineer and refinery engineer.

Foreign Process License Plan Is Made by Houdry

Houdry Process Corporation has made arrangements with World Commerce Corporation to represent Houdry in negotiating foreign process licenses throughout the world. Houdriflow catalytic cracking and Houdriforming for catalytic reforming are among the processes to be marketed. In addition, engineering and design services and the facilities of the Houdry laboratories at Linwood, Pa., will be made available.

Curtis Gerald Rejoins Universal Oil Products

Dr. Curtis F. Gerald has joined the engineering, research and development department of Universal Oil Products Company, Chicago. Dr. Gerald, associated with Universal from 1942 to 1947 at its Riverside, Ill., laboratories, returns to the company after an absence of four years, during which time he served as

Valves can be operated the hard way, too...

but —

LIMITORQUE
PUSH BUTTON OPERATION

...is cheaper, safer, automatic, positive and dependable

LimiTorques are available for all types of valves and may be supplied for actuation by any power source such as electricity, steam, gas, oil or air. Write for LimiTorque catalog L-50 on your business letterhead.

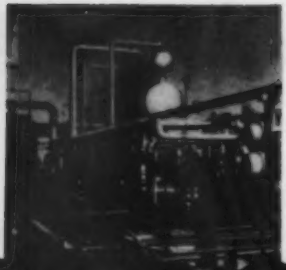
Philadelphia Gear Works, INC.

ERIE AVE. AND G ST., PHILADELPHIA 34, PA.
NEW YORK • PITTSBURGH • CHICAGO • HOUSTON • LYNCHBURG, VA.
IN CANADA: WILLIAM AND J. G. GREEY LIMITED, TORONTO

Industrial Gears and Speed Reducers
LimiTorque Valve Controls

WORLD PETROLEUM

22 New Alkylation Units Planned



Petroleum Administration for Defense approves accelerated amortization for alkylation plants to cost $36 million.

ALKYLATION is currently enjoying a major resurgence as a result of both increased military requirements and the challenge of the high compression ratio automotive engine. This is apparent not only in announcements of new plant construction but even more dramatically in a recent tabulation issued by the Petroleum Administration for Defense in which the PAD lists applications for accelerated amortization. These, including facilities for basic refining, alkylating, production of aromatics and other refining and petrochemical operations, amount to more than half a billion dollars.

Over seven percent of this total will go for 22 alkylation plants and supporting facili-

A large proportion of the proposed increase in capacity can be laid directly at the feet of the aviation industry which has produced the powerful reciprocating engines that require 115/145 grade avgas rather than the 100/130 grade used during World War II.

To produce this grade not only calls for high quality alkylate but also greater production because the problem is further compounded by the fact that today's engines require a blend of which approximately 85 percent may be alkylate, the remainder being largely composed of isopentane and aromatics. This is more than double the 35 percent alkylate content needed in World War II.

Thus, although alkylation produced

The Cameron

NON-LUBRICATED

LIFT-PLUG VALVE

-designed especially for alkylation service

This is the valve that was developed expressly for HF and H_2SO_4 Alkylation service. Its performance in this difficult service has been so outstanding that it is now being widely used wherever corrosion, elevated temperatures or high pressures are factors.

The seat, which is separate from, and not attached to, the valve body, may be readily replaced without removing the valve from the line. Obviously, the seat and plug may be had in any desired alloy for special service conditions. The non-lubrication feature eliminates the bother and expense that goes with lubricated valves, and prevents product contamination. The valve operates with remarkable ease and seals tightly without the aid of lubricant.

Cameron IRON WORKS, INC.

P. O. BOX 1212. HOUSTON, TEXAS

Export: 74 Trinity Place, New York, N. Y. Represented in the sterling area by: British Oilfield Equipment Co., Ltd., Duke's Court, St. James' s, London S.W.1, Eng.

The MONTH...

an assistant professor of chemical engineering at the University of Washington, Seattle.

A graduate of Iowa State College and holding graduate degrees from the University of Cincinnati and Massachusetts Institute of Technology, Dr. Gerald is a member of the AIChE and the American Chemical Society.

Phillips Operating Group Now Headed by McCullough

G. W. McCullough, former executive vice president and general manager of Phillips Chemical Company and Phillips Terminal Company, has been named chairman of the operating committee of Phillips Petroleum Company, replacing J. E. Bogk, resigned.

McCullough

T. L. Cubbage, named vice president and general manager of the two companies will direct operations, but McCullough will continue as director and executive vice president.

McCullough, an Oklahoma A. & M. College graduate, joined Phillips in 1925 as draftsman and design engineer. He was appointed vice president and general manager of Phillips Chemical in 1948, and became executive vice president early this year.

Cubbage, a Phillips employe since 1930, is a graduate of the University of Oklahoma. Before becoming vice president and assistant manager of Phillips Chemical in 1944 he acted as superintendent of the plant at Borger.

Grease Institute Annual Meeting Slated at Chicago

Members of the National Lubricating Grease Institute will hold their annual meeting at the Edgewater Beach Hotel, Chicago, October 29-31. Some of the papers to be presented:

"Electron Microscope Studies of Lithium Greases: Relationship of Soaps Structure to Composition: Processing and Properties" by J. A. Brown, C. N. Hudson and L. D. Loring, Sinclair Research Laboratories, Inc., Harvey, Ill.

"Grease Milling and Deaeration" by G. H. Morehouse, Morehouse Industries, Los Angeles.

"Fretting Corrosion", T. G. Roehner, Socony-Vacuum Laboratories, Brooklyn.

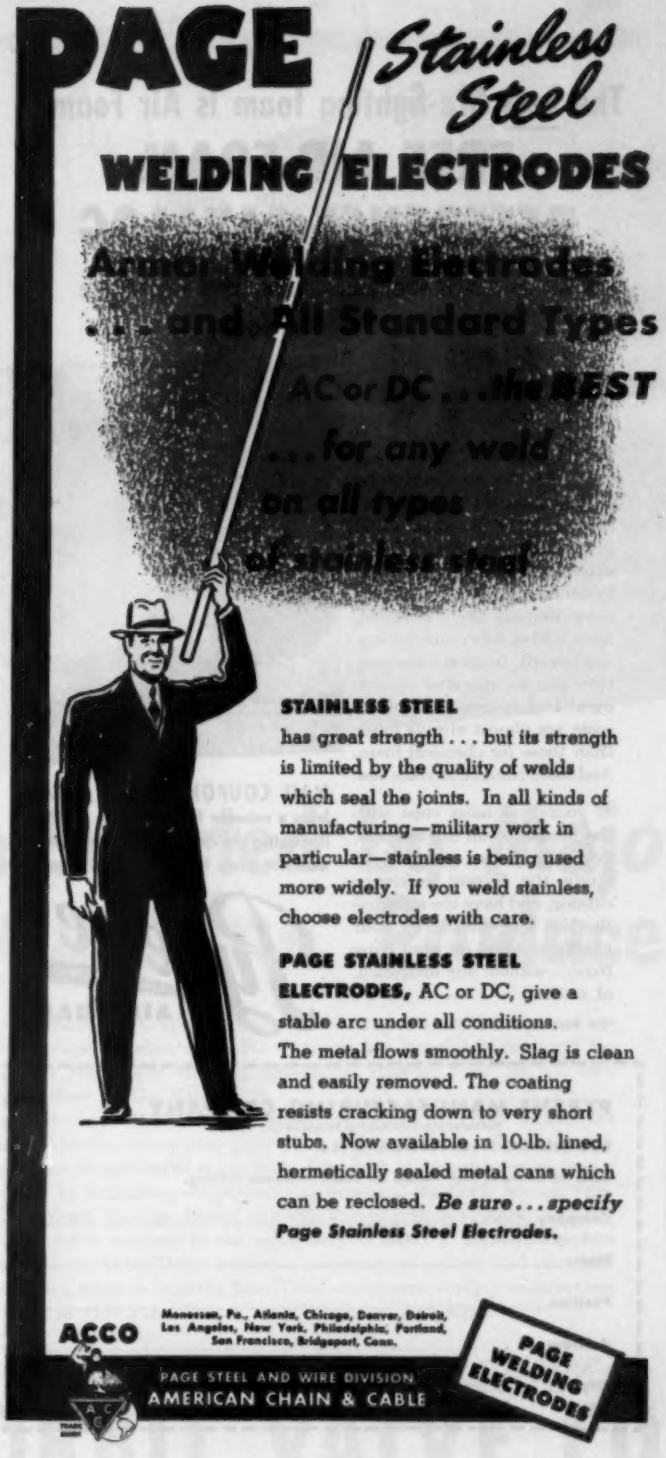
"Development of Soda Base Greases," A. Bondi, Shell Development Company, Emeryville, Calif.

"Why Don't We Teach the Principles of Lubrication to Our Engineering Students?" by W. J. Ewbank, Cato Oil and Grease Company, Oklahoma City.

OIIC Offers Oil Movie

The wresting of today's high standard of living from nature and the land is the theme of a new motion picture produced under the sponsorship of the Oil Industry Information Committee. It is especially released for showing during Oil Progress Week and will be available thereafter.

Entitled "Man on the Land," the action-packed motion picture was made for the Committee by United Productions of America, the firm which won an Academy Award in 1950 for an animated


PAGE Stainless Steel
WELDING ELECTRODES
Armor Welding Electrodes
... and All Standard Types
AC or DC ... the BEST
... for any weld
on all types
of stainless steel
STAINLESS STEEL
has great strength ... but its strength is limited by the quality of welds which seal the joints. In all kinds of manufacturing—military work in particular—stainless is being used more widely. If you weld stainless, choose electrodes with care.
PAGE STAINLESS STEEL ELECTRODES, AC or DC, give a stable arc under all conditions. The metal flows smoothly. Slag is clean and easily removed. The coating resists cracking down to very short stubs. Now available in 10-lb. lined, hermetically sealed metal cans which can be reclosed. Be sure ... specify Page Stainless Steel Electrodes.
ACCO
Manoessen, Pa., Atlanta, Chicago, Denver, Detroit, Los Angeles, New York, Philadelphia, Portland, San Francisco, Bridgeport, Conn.
PAGE STEEL AND WIRE DIVISION
AMERICAN CHAIN & CABLE
PAGE WELDING ELECTRODES

The best fire-fighting foam is Air Foam!

FREE AIR FOAM REFERENCE CATALOG

Air Foam is more effective, less expensive than chemical foam

Pyrene* Air Foam is the finest fire protection yet devised for oil fire hazards. It extinguishes fast, prevents flash-backs and re-ignition, is *compact* and extremely flexible. Pyrene* Air Foam is available in America's most complete line of portable, fixed, and mobile units, for any size hazard. In most instances, they can be operated by one man! Installation and upkeep costs are almost always lower than those for chemical foam. And foam compound costs less.

If your firm must cope with the danger of oil fire hazards, you owe it to yourself to study the Pyrene reference catalog, and have the information in it available at your fingertips. Send for your copy today—without any obligation, of course.

*T.M. Reg. U.S. Pat. Off.

MAIL COUPON TODAY! It will bring a valuable FREE reference booklet illustrating and describing air foam equipment for every type of oil fire hazard.

Pyrene® REG. U.S. PAT. OFF. AIR FOAM

PYRENE MANUFACTURING COMPANY
(affiliated with C-O-Two Fire Equipment Co.)
682 Belmont Ave., Newark 8, N.J.

Send me the new, free Pyrene Air Foam reference catalog.

Company_____

Name_____

Position_____

Address_____

City_____ Zone____ State_____

The MONTH...

motion picture. The same style of animation and color is used in "Man on the Land."

Interior Repeats Views on Synthetic Fuel Projects

Government support of synthetic fuel plants "is justified by their relation to national defense" in the opinion of Assistant Interior Secretary, Robert Rose, Jr., expressed in a letter to Senator Robert S. Kerr (D.), Oklahoma.

A 30,000-barrel-daily coal hydrogenation plant would require 200,000 tons of steel according to Interior figures, a requirement which has called forth much criticism in congressional and industrial circles. In counter-attack the Department of the Interior claims that a barrel of oil by coal hydrogenation requires approximately 2.8 pounds of steel for production, while crude oil production requires 4.6 pounds of steel.

F. Eberstadt and Company, through Colchem Corporation, has proposed that industry erect such a plant or plants, conditional upon a governmental contract guaranteeing current price levels for the products. Koppers Company of Pittsburgh has been consulted as to the cost and requirements of such a plant, but no contract has been let.

Bituminous, sub-bituminous and lignite coal are good sources of oil from coal and the Corps of Army Engineers has reported that such reserves in Illinois are the equivalent of 34 billion barrels of synthetic liquid fuel. Oklahoma, proposed as a site for such a plant, is estimated by the engineers to hold a reserve sufficient for the processing of 2 billion barrels of synthetic oil.

The Department of the Interior is stressing the need of getting such a program underway as a valuable long term investment. "The limited nature of domestic petroleum reserves together with growing uncertainty as to availability of foreign oil... dictates immediate exploitation of oil shale and coal deposits," wrote Rose.

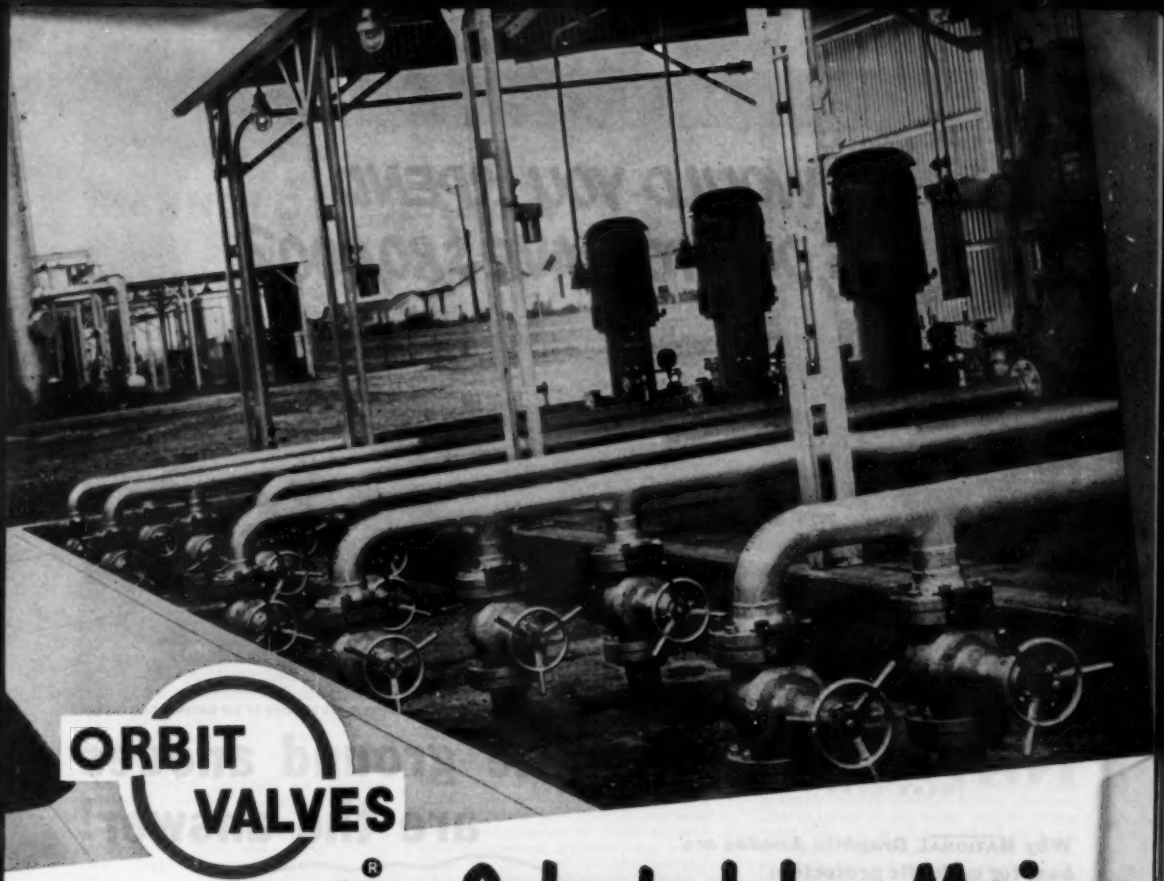
Recognizing that the initial contribution from coal hydrogenation to the liquid fuel supply would be small, Interior officials have previously stated: "An important consideration, however, is the development of techniques, trained manpower, and continuous improvement in processes, under commercial conditions, toward the day when significant quantities of liquid fuel must be obtained from synthetic production.

Immediate advantages of such a project, according to Interior officials, would be the "production of substantial amounts of aromatics now in short supply."

Houdry Announces Changes

New additions to the staff of the research division of the Houdry Laboratories, Linwood, Pa., are Sterling E. Voltz and Hiroshi Shimizu. Dr. Voltz recently received his Ph. D. in physical chemistry at Temple University. Dr. Shimizu received his Ph. D. in metallurgy at the University of Utah.

Recent promotions at the Houdry Laboratories are those of Dr. Heinz Heinemann as section leader in charge of process research and E. R. Boedeker as section leader in charge of exploratory research.



ORBIT VALVES®

again Selected by Major Natural Gasoline Producer

BRANCHES

HOUSTON, TEXAS
607 Velasco
(Serving the Gulf Coast)

OSSINA, TEXAS
Short Warehouse
(Serving West Texas)

CASPER, WYOMING
The Great Western Co.
(Serving the Rocky Mountain States and Canada)

Warren Petroleum Corporation, one of the largest manufacturers and exporters of Natural Gasoline and LPG Products has completely equipped the above Loading Pumps and Manifold installation, Holliday Plant No. 27, with Orbit Forged Steel LP Gas Valves.

More and more LP Gas manufacturers are turning to Orbit because the Orbit resilient friction free seating principle is a natural for handling Liquefied Petroleum Gases. Regardless of minor body deflections, contractions or expansion brought about by fluctuating temperatures or pressures, the Orbit Seating Principle is not affected. You can depend on Orbit Valves in an emergency. No lubricant of any kind is required in the valve body to effect a shut-off, therefore maintenance of the Orbit Valve requires a minimum of expense and attention.

Offered in Carbon or Stainless Steel Trim—maximum working temperatures of 250° Fahr. or 375° Fahr. Sizes 1" to 4" inclusive. ASA Class.

SOLD BY SUPPLY STORES

ORBIT VALVE CO.

P. O. BOX 699 TULSA, OKLAHOMA

WOULD YOU SPEND $15,000 TO SAVE $80,000?

GROUND ANODE SYSTEM SURVEYED AND DESIGNED BY THE HINCHMAN CORPORATION

NATIONAL TRADE-MARK graphite ground anodes are the answer!

Why NATIONAL Graphite Anodes are best for cathodic protection

- Positive control in any moisture condition; just change a tap on the rectifier to raise or lower current input as required.
- Perfect for use in high resistance soils.
- Longest life of any anode material obtainable.
- Lowest-cost, long-range protection.
- Thoroughly tested and proved in service for more than 20 years.
- Also, complete and sure protection in sea water — indefinitely.

The term "National" is a registered trade-mark of Union Carbide and Carbon Corporation

NATIONAL CARBON COMPANY
A Division of
Union Carbide and Carbon Corporation
30 East 42nd Street, New York 17, N. Y.

District Sales Offices:
Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco
In Canada: National Carbon Limited
Montreal, Toronto, Winnipeg

Because of leaks in the piping, the city of Detroit, Michigan, would have spent $80,000 on space heaters — resulting in a far less efficient heating job — to replace their radiant-heating systems installed under two large maintenance and storage garages.

The two garages handled 1000 buses . . . had 500,000 square feet of floor space. Their floors were heated by 110,000 feet of buried iron and steel pipe in 233 heating panels. Purpose of the buried heating unit was to melt snow and ice from the undersides of the buses during storage in preparation for maintenance work. Detroit, like many other cities, uses salt for ice and snow removal. The melted snow, therefore, formed a corrosive, salt-water solution. When this salt water soaked down among the buried pipes, it caused corrosion leaks.

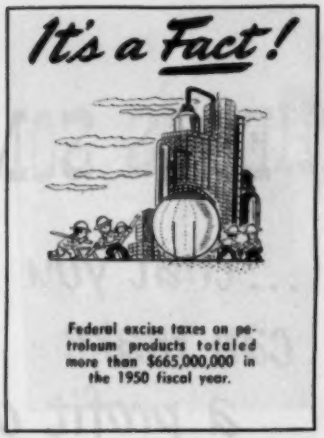
Detroit's answer was to install cathodic protection, using graphite ground anodes to protect the metal piping. Sixty-eight 4" x 40" "National" graphite anodes were placed under each garage. Two anodes were placed in each hole made through the concrete floor, the holes being spaced 57' to 102' apart. Cost of this installation, which is providing ample protection, was only $15,000.

DO YOU HAVE A SIMILAR PROBLEM? CATHODIC PROTECTION MAY BE YOUR ANSWER!

Cathodic protection saves steel!

SCIENCE and TECHNOLOGY Abstracts

Prepared by
DR. E. H. LESLIE and DR. H. B. COATS
The Leslie Laboratories
Traver Road, Ann Arbor, Mich.



Fundamental Physical and Chemical Data

Vapor Pressure of Neopentane. The Vapor Pressure and Critical Constants of Neopentane. J. A. BEATTIE, D. R. DOUSLIN, AND S. W. LEVINE. *J. Chem. Phys.*, **19** (1951), pp. 948-9.

The vapor pressure of neopentane, from 50° to the critical temperature, 160.60° C. was measured. Also the compressibility in the critical region was determined at a sufficient number of isotherms to locate the critical point. The critical pressure, volume and density are as follows: $t_c = 160.60° \pm 0.05°$ C, $p_c = 31.57 \pm 0.03$ normal atmospheres, $V_c = 0.303$ liter per mole, $d_c = 3.30$ moles/liter. The uncertainty in the critical volume and density is believed to be 1 percent.

An Empirical Equation for Thermodynamic Properties of Light Hydrocarbons and Their Mixtures. Constants for Twelve Hydrocarbons. MANSON BENEDICT, GEORGE B. WEBB, AND LOUIS C. RUBIN. *Chem. Eng. Progress*, **47** (1951), pp. 419-22.

The series of papers, of which this is one, describe an empirical equation that represents classes of thermodynamic properties of light hydrocarbons and their mixtures, either as gases or liquids as follows: a) Pressure-volume-temperature-composition data, b) Isothermal change of enthalpy and entropy with pressure, c) Latent heats of vaporization and heats of mixing, d) Fugacities and vapor-liquid equilibria.

The use of a single equation to represent these thermodynamic properties has many advantages. Previous papers have covered the properties of methane, ethane, propane, *n*-butane, iso-butane and ethylene. This paper brings together numerical values of the constants for these hydrocarbons and for six additional hydrocarbons, including propylene, isobutene, isopentane, *n*-pentane, *n*-hexane, and *n*-heptane. The equation of state is described and the values of the constants is given. A bibliography of 41 references is included.

Equilibrium Relations of Two Methane-Aromatic Binary Systems at 150 F. M. ELBISHLAWI AND J. R. SPENCER. *Ind. Eng. Chem.*, **43** (1951), pp. 1811-5.

Data in the literature on solutions of methane and hydrocarbons indicate a correlation between the chemical nature of the solvent or liquid phase and the solubility of methane. The chemical nature of the solvent can be expressed in terms of a characterization factor. The purpose of the present work was to test the correlation for low values of the characterization factor and for solvents containing aromatic hydrocarbons. Equilibrium constants for the systems methane-benzene and methane-toluene substantiate the correlation even to the extreme ranges of the factors. If, as the data on these binary systems suggest, solubility of methane in crude oil-natural gas systems depends in a similar way on the chemical character of the liquid phase, the prediction of the phase behavior of the component in petroleum reservoirs would be greatly facilitated. Data secured in the course of the work are presented in detail in tabular and graphical form, and a bibliography of 15 references is included.

Spiral Growth of n-Paraffin Crystals. The Observation of Spiral Growth-Steps in n-Paraffin Single Crystals in the Electron Microscope. I. M. DAWSON AND V. VAND. *Proc. Roy. Soc.*, **206-A** (1951), pp. 555-62.

The electron miscroscope was used to study the structure of single crystals of some n-paraffins. Evidence was found of spiral growth-steps on the surface of these crystals. n-Hexatriacontane was used in the present investigation. Crystals were prepared by evaporation of a dilute solution of the compound in petroleum ether. n-Hexatriacontane exists in a number of polymorphic forms. Measurements of the interfacial angles on individual crystals, by x-ray diffraction and by electron-diffraction, established that the crystal studied was orthorhombic. Electron micrographs show the successive monomolecular steps on the growing face of the crystal. These are seen not as a succession of closed parallelograms, but as a spiral running from the apex of the crystal to its base. Visual confirmation is thus afforded of crystal growth by spiral growth-steps. Nothing was found to substantiate the idea of long-range migration of molecules over the growing face of the crystals. Molecules condense only on the developing edge.

These abstracts from the current literature of science and technology (not including trade journals easily available) were prepared by Drs. Leslie and Coats of The Leslie Laboratories, Traver Road, Ann Arbor, Mich., which will supply, at cost, photostatic copies of original articles. Complete or limited bibliographies covering special topics by title, by abstracts, or in complete manuscript, also may be had by arrangement with the laboratories.

Chemical Composition and Reactions

Kinetics of Catalytic Sulfurization of Methane. R. C. FORNEY AND J. M. SMITH. *Ind. Eng. Chem.*, **43** (1951), pp. 1841-8.

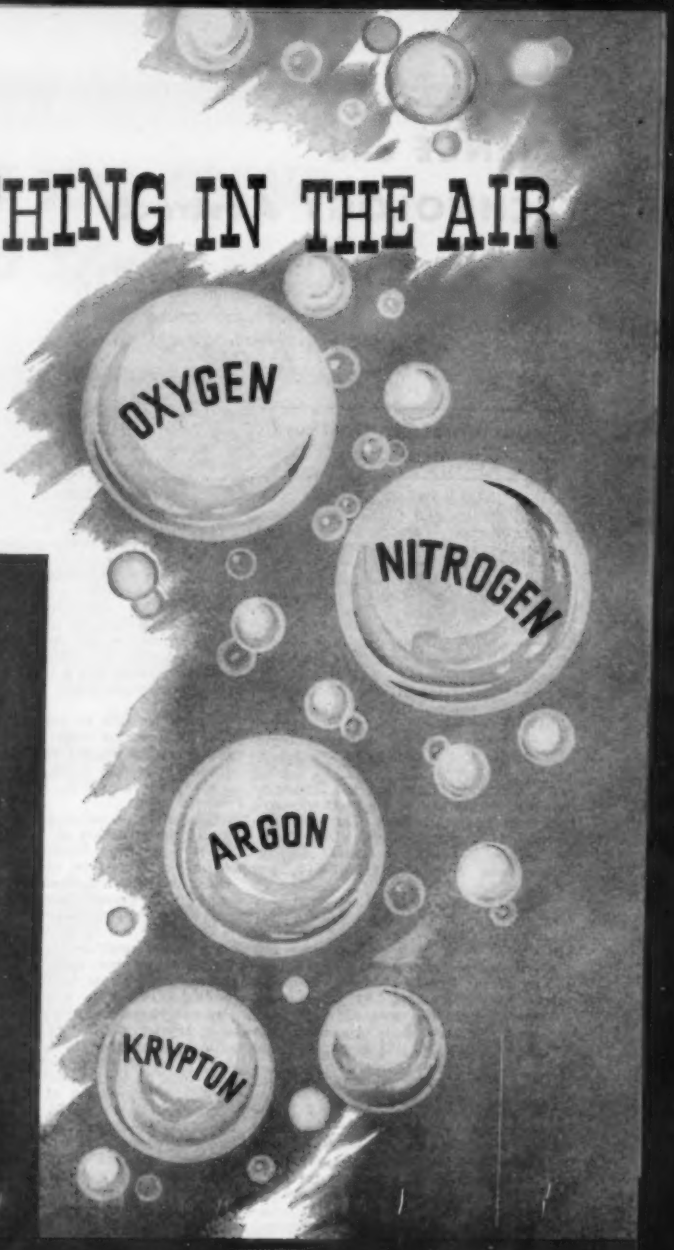
Although the production of carbon disulfide from methane and sulfur is a commercial process, there are few data available on the kinetics of the reaction. The purpose of the work was to secure basic data, such as the effect of mass transfer on the reaction rate as well as an expression for the mechanism of the surface reaction, methane and sulfur vapor were contacted at 600° C. and one atmosphere pressure under varying conditions of catalyst bed depth, molar ratio of reactants, and feed rate of reactants. It was concluded that diffusional resistance has only a negligible effect on the reaction rate at such mass velocities as were studied. The reaction is apparently a simple second-order reaction involving methane and diatomic sulfur. It is believed that the data will aid in reactor design for the process. The data are presented in detail in tabular and graphical form and a bibliography of twelve references is included.

Catalytic Isomerization of Isomeric Hexanes. B. L. EVERING AND R. C. WAUGH. *Ind. Eng. Chem.*, **43** (1951), pp. 1820-3.

The five isomeric hexanes that coexist at equilibrium afford the simplest system for studying the sequence in which the individual isomers are produced in the course of isomerization. The work reported was undertaken to determine the manner and rate of isomerization of the hexane isomers to aid in establishing optimum conditions for commercial isomerization units. The results indicate that the isomerization of n-hexane to its several isomers occurs in a stepwise manner, but the steps do not take place with equal ease. Methylpentanes are first formed from n-hexane relatively slowly. Equilibrium between 2-methylpentane and 3-methylpentane is established rapidly. The rate of formation of 2,3-di-

THERE'S SOMETHING IN THE AIR

...that you can make a profit on!



All of the valuable components in the air you breathe can be separated for industrial use in high purity.

OXYGEN for steel production, non-ferrous metallurgic welding and cutting, synthetic fuels and chemical processes;

NITROGEN for synthetic ammonia and inert atmospheres;

ARGON for shielded arc welding;

ARGON and **KRYPTON** for incandescent lamps.

Complete plants, using processes based on the developments of Gesellschaft fuer Lindes Eismaschinen, A. G., for producing these gases singly or in combination are furnished to fit your requirements.

Blaw-Knox also furnishes complete Linde plants for the separation of industrial gases such as coke oven gases, natural gas containing nitrogen, purged gases from ammonia synthesis, nitrogen-hydro-carbon mixtures, cracked refinery gases and mixtures of hydrogen or carbon monoxide.

CHEMICAL PLANTS DIVISION

BLAW-KNOX CONSTRUCTION COMPANY

PITTSBURGH • TULSA • NEW YORK • PHILADELPHIA
CHICAGO • BIRMINGHAM • WASHINGTON, D. C.

methylbutane from the methylpentanes is intermediate. Neohexane, or 2,2-dimethylbutane, proves to be difficult to form, but once formed it is stable under isomerization conditions. Data established that it is important to operate close to the equilibrium octane number in order to obtain the maximum yield of neohexane in the commercial neohexane unit. A bibliography of nine references is included.

The Quantitative Inversion of cis- and trans-Alkene Isomers: A New Synthesis of Normal cis-Alkenes. MELVERN C. HOFF, KENNETH W. GREENLEE AND CECIL E. BOORD. *Jour. Am. Chem. Soc.*, **73** (1951), pp. 3329-36.

To further a program for the preparation of hydrocarbons it was desired to develop a method for the production of normal *cis*-alkenes suitable for use in the preparation of standard hydrocarbon samples for use in engine testing. The authors describe a new method for quantitatively inverting the configuration about the carbon to carbon double bond in *n*-alkenes. This involves molecular chlorination, alkaline dehydrochlorination, and dechlorination by sodium in ammonia. The procedure was applied to the *trans*-isomers of 2-pentene, 2-hexane, 3-hexene, 2-octene and 4-octene and also to the *cis*-isomer of 3-hexene. Physical properties of the five *cis*-alkenes that were prepared are given. The inversion method appears to be generally applicable to isolated double bonds. The inversion method yields purer *cis*-2-hexene and *cis*-2-octene than catalytic hydrogenation, but catalytic hydrogenation yields purer *cis*-3-hexene and *cis*-4-octene.

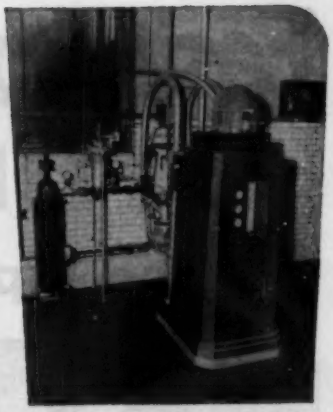
Dehydrogenation of p-Cymene. KENNETH A. KOBE AND ROBERT T. ROMANS. *Ind. Eng. Chem.*, **43** (1951), pp. 1755-8.

P-cymene, or isopropyltoluene, is a hydrocarbon occurring as a by-product of sulfite pulping of eastern spruce. A dehydrogenation product, p,α-dimethylstyrene could be used in synthetic rubber an other polymers. The dehydrogenation of p-cymene into p,α-dimethylstyrene was studied using a chrome-alumina catalyst and a temperature range from 900° to 1100° F. Yields of 80 percent of substituted styrenes can be obtained at a conversion yield of 50 percent per pass. P,α-dimethylstyrene copolymerizes with butadiene to give a synthetic rubber superior to GR-S in tensile strength and resembling natural rubber in characteristics. It is felt that the production of p,α-dimethylstyrene will give an outlet for p-cymene which is now wasted by sulfite pulp mills.

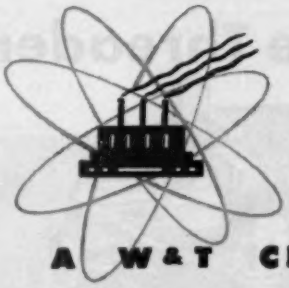
The Frequency of the Third Harmonic O-H Band of Methanol in Various Solvents, and the Hydrogen Bonding of Methanol with Aromatic Hydrocarbons. LLEWELLYN H. JONES AND RICHARD M. BADGER. *Jour. Am. Chem. Soc.*, **73** (1951), pp. 3132-4.

The absorption spectra of dilute solutions of methyl alcohol in several solvents was observed in the region of the third harmonic of the OH band. In nonpolar solvents OH frequency is shifted from its position in the vapor by an amount proportional to $(D-1)/(2D+1)$ where D is the static dielectric constant of the medium. In some polar chlori-

SAXTON'S SECRET WEAPON . . .



W&T Chlorinator Installation at Saxton Station



A W&T CHLORINATOR

In winning their battle against condenser slime at the Saxton Generating Station, Pennsylvania Electric Company, in their company publication, called the Wallace & Tiernan Chlorinator their "Secret Weapon."

Here's what happened before chlorine was tried. Experience showed even a small accumulation of slime caused a one inch loss in condenser vacuum — equivalent to a five to ten per cent reduction in plant efficiency. Frequent mechanical cleaning — expensive and disagreeable — still left a thin layer of slime. Cleaning compounds involving acids and alkalis were found an unsatisfactory answer to the problem.

Then Chlorine was tried! Preliminary tests indicated that coal consumption could be decreased by about $75 per day. *But*, feeding chlorine without special equipment proved both expensive and dangerous. A slight variation in feed rates resulted either in insufficient treatment or excessive chemical costs.

As a result of these tests, a Wallace & Tiernan Automatic Chlorinator was installed at Saxton in May 1949. This precision chlorinator made possible reduced coal consumption and virtual elimination of mechanical tube cleaning — the reasons why a W&T Chlorinator is Saxton's "Secret Weapon."

Hundreds of power plants have had benefits similar to those at the Saxton Station. Your W&T Engineer is prepared to help solve your slime problems — why not write for more information today — no obligation, of course.

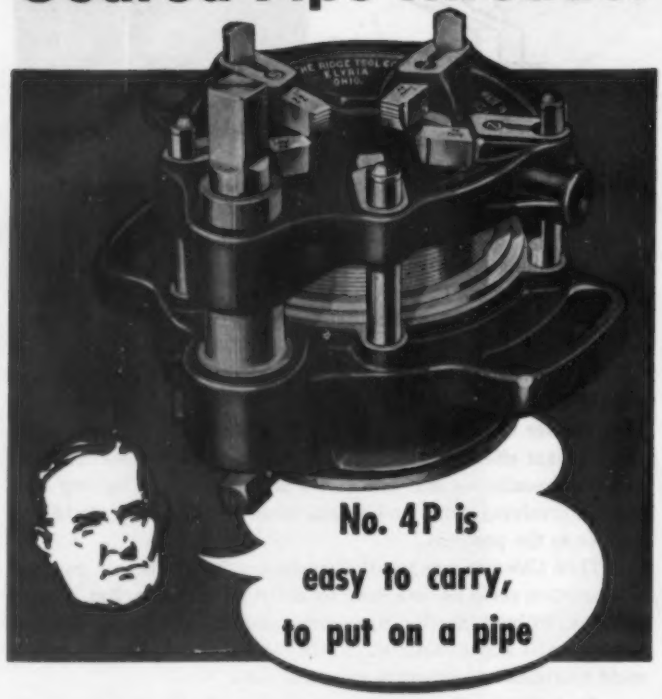
CD-36

WALLACE & TIERNAN PRODUCTS, INC.

CHLORINE AND CHEMICAL CONTROL EQUIPMENT

Belleville 9, New Jersey • Represented in Principal Cities

Easier to Handle this RIDGID Geared Pipe Threader



● You'll like the balanced loop handles that make it easy to swing the 4P around where you want it. Making it still more of a work-saver, mistake-proof workholder sets to size *before* you put it on pipe—only one screw to tighten, no bushings to fool with. 4 sets of 5 high-speed steel chaser dies give quick, clean threads on 2½", 3", 3½" and 4" pipe. Ratchet handle furnished—for power threading use with RIDGID Universal Drive Shaft and Power Drive. Save your muscles—buy this easier-to-handle RIDGID 4P at your Supply House.

RIDGID

★ Work-Saver Pipe Tools ★

nated solvents the frequency shift is less, but in aromatic solvents the large shift is taken as an indication of hydrogen bond formation. The author regards the data as evidence that methanol molecules are bonded to aromatic hydrocarbon molecules by a hydrogen bond of moderate strength involving the hydroxyl hydrogen.

Manufacture: Processes and Plant

An Algebraic Representation of Vapor-Liquid Equilibria. WALTER H. PRAHL. *Ind. Eng. Chem.*, **43** (1951), pp. 1767-70.

The author calls attention to the need for a simple algebraic relation between y, the mole fraction in the vapor phase, and x, the mole fraction in the liquid phase, of binary systems. An empirical equation was developed that expresses this relationship in terms of three constants, that can be determined from a straight-line plot. Since this equation connects x and y directly through a simple relation, it permits simple algebraic treatment of many calculations that otherwise require complicated calculation, or that can only be handled graphically. It can be used to smooth experimental data in preparation for a thermodynamical treatment. It can replace the graphical procedure of the McCabe-Thiele method for determining the number of theoretical plates, by a faster and more accurate arithmetical procedure. It permits interpolation and extrapolation of experimental x-y curves, as well as calculation of azeotropic composition. Samples of the application of the procedure to specific problems are given.

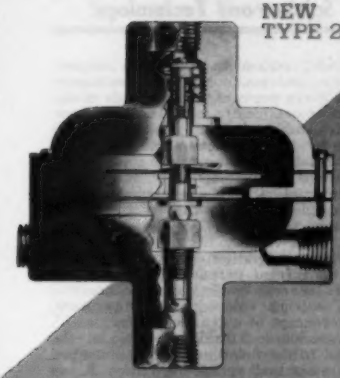
Limiting Flows in Packed Extraction Columns. Correlation for Large Packings. J. W. CRAWFORD AND C. R. WILKE. *Chem. Eng. Progress*, **47** (1951), pp. 423-31.

Data have been published on the flow phenomena in one-quarter inch and one-half inch packings, but there have been no data on large packings. The authors also wish to test the correlations that have previously been published. Data are reported for limiting flows of various liquids in a twelve-inch diameter tower packed with one-half inch, one inch, and one and a half inch carbon Raschig rings. A new correlation is presented that fits available data for columns packed with rings of one-fourth inch to one and a half inch nominal diameter and one-half inch Berl saddles and clay spheres. A sample design calculation is included to illustrate the application of the method described. A bibliography of nine references is given.

Diffusion Rates in Extraction of Porous Solids. 1. Single Phase Extractions. EDGAR L. PIRET, R. A. EBEL, C. T. KIANG, AND W. P. ARMSTRONG. *Chem. Eng. Progress*, **47** (1951), pp. 405-14.

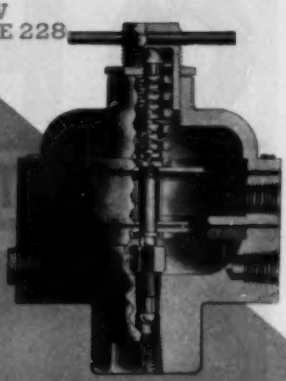
The authors emphasize that it is important to study rates at which materials diffuse into or from a porous body, since such knowledge has application in solid-liquid extraction and in catalysis. In the experimental work aqueous solutions of potassium chloride, sodium

NEW
TYPE 227



A delayed action, fixed ratio relay. For use with series-operating diaphragm control valves in "split ranges". Permits full valve travel with primary control pressure changes as low as 2 or 3 pounds.

NEW
TYPE 228



Reverse action relay delivers maximum pressure output at minimum input or vice versa. No modification in either pilot or valve hook-up necessary. Or install in bypass to achieve reversal of valve closure in relation to pilot action if required occasionally.

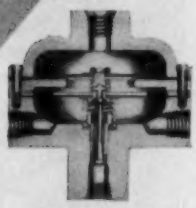
Get greater speed of action ...Install BS&B "Climax" Relays

• BS&B "Climax" Relays serve as primary regulator valves to step up the action through the control of supply medium to the control valve.

The wide BS&B "Climax" line provides a variety of functions ... one-to-one, fixed ratio, variable ratio, delayed or reverse action. They may be used to load diaphragms or pistons with liquid operating medium while the control instrument loads the relay with gas. Booster action is also possible, to enable small capacity controls to handle larger duties.

Write today for the latest illustrated catalog Section 109, complete with descriptions, performance figures, installation data.

TYPE 209
1 to 1 Ratio

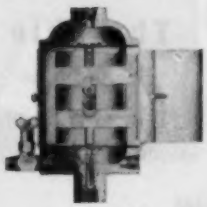


TYPE 217-4A
Fixed Ratio

BLACK, SIVALLS & BRYSON, INC.
Climax Controls Division
Adv. Dept. Room 53F 7502 East 12th St. Kansas City 3, Mo.

BS&B

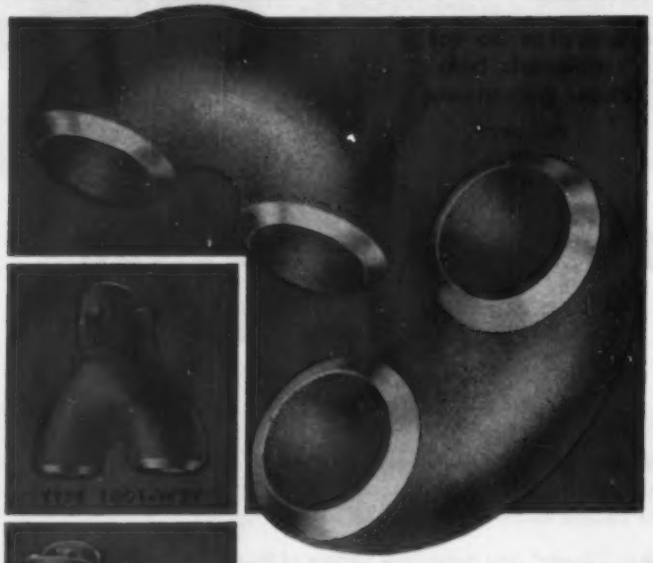
"Climax"
RELAY REGULATORS



TYPE 224
Variable Ratio

OHIO

WELDING-TYPE FITTINGS



CAST WELDABLES GIVE YOU:

1. Lower cost
2. Longer life
3. Shorter centers
4. Heavier walls

They can be furnished for all tube and pipe sizes, and I.D. and wall thickness; on close center dimensions; from any type of cast material.

IMPORTANT. In your specifications send us: I.D. of tube; O.D. of tube; operating conditions; inlet and outlet pressures and temperatures; center dimensions.

Three of the welding fittings shown here have cleanout or inspection openings equipped with Ohio Type 1000 closures. Other closures are available.

The Ohio Steel Foundry Company

LIMA, OHIO

PLANTS AT LIMA AND SPRINGFIELD, OHIO

chloride, potassium chromate, copper sulfate, and acetic acid were extracted from three types of carrier solids of increasing complexity, namely, single capillaries, tubes containing beds of small glass beads, and porous alumina spheres. The tranfer mechanism was found to be diffusional. Equations were derived for the extraction of a single phase solute from spheres in the case of batchwise, counter-current, and co-current operation. The validity of the equation for batchwise operation was verified by extractions from porous alumina spheres under several conditions of concentration, solvent volume and temperature. The concept of a pore shape factor, K^1, is introduced. This is the ratio of the actual to the theoretical extraction time. For an actual sphere of radius R, an equivalent, idealized sphere of radius KR, can be assumed, the structure of which latter sphere offers no resistance to diffusion. This factor is used in interpreting and correlating the extraction data.

Heat Transfer and Heat Release in Fluidized Beds. NORMAN L. CARR AND NEAL R. AMUNDSON. *Ind. Eng. Chem.*, **43** (1951), pp. 1856-62.

Heat transfer and the release of heat in fluidized catalytic beds is a major factor in the design of these reactors as well as in their operation. In spite of the importance of the problem few data are available in the literature. The present paper reports part of an investigation of the interaction of fluids and solids in fixed, moving, and fluidized beds in which the main concern is the operation effected in the bed. The investigation was begun with the idea in mind of determining in a theoretical manner the temperature relations in a fluidized bed, as these depend upon flow and mixing assumptions. Formulas were derived relating operating variables and physical parameters for heat transfer and heat release for two typical cases. In the first case it was assumed that conductivity in the solid might be a limiting factor. In the second case conduction in the solid was neglected. It is shown that for heat transfer alone and for particles of the size ordinarily used in fluidization practice the two cases give almost identical results. With the assumptions of random motion of the particles in the bed and complete mixing of the fluid, the simple case was sufficient for design purposes. This affords a simplification that diminishes the calculations and aids the experimenter in the determination of heat transfer coefficients between the fluid and the particle. The work is being continued in order to determine the effect of other fluid and other solid mixing assumptions.

Locating Fluidized Solids Bed Level in a Reactor. Hot Wire Method. G. L. OSBERG. *Ind. Eng. Chem.*, **43** (1951), pp. 1871-3.

A hot wire method for locating the fluidized solids bed level in a reactor offers a practical alternative to the pressure drop method commonly employed for determining and controlling the depth of the bed. The hot wire method is based on the well-established observation that the heat transfer rate from a hot surface is much higher in a fluid-

ized bed of solids than in a fixed bed or in gas alone. Thermally sensitive elements are a part of a thermal conductivity bridge and are mounted in a probe. Details of construction and performance of a laboratory unit are presented. It is believed that this type of level probe will be particularly useful in high pressure units. The probe could be incorporated in automatic bed level control equipment.

Extraction in a Pilot-Unit Spray Tower. CHRISTIE J. GEANKOPLIS, PAUL L. WELLS, AND ELLIS L. HAWK. *Ind. Eng. Chem.*, **43** (1951), pp. 1848-56.

Few data are available of the performance of spray-type extraction towers and such data as do exist are relatively limited in their use because they are applicable only to the specific column for which the data were obtained and not to columns of different lengths, numbers of nozzles, and other varying structural features. The present work was done to study the mechanism of extraction and to answer some of the questions raised by previous investigators. Data on extraction coefficients were obtained using a pilot-unit spray tower and the system toluene-acetic acid-water. Internal samples were taken in order to obtain internal mass transfer coefficients. These were found to be approximately constant. A large end effect was noted at the continuous phase inlet. It appears that neither the type of system employed nor the direction of solute transfer had any effect on the location of the end effect. A method is proposed for correlating end effects expressed as a fictitious height of column and also of correlating mass-transfer coefficients. The authors believe that the accumulation of more data using different systems and different towers will permit a general correlation of spray tower extraction data. Results are given in some detail in tabular and graphical form and a bibliography of eleven references is included.

Drying Granular Solids in Superheated Steam. LEONARD WENZEL AND ROBERT R. WHITE. *Ind. Eng. Chem.*, **43** (1951), pp. 1829-37.

Superheated steam is an attractive drying agent for materials that are not temperature sensitive. The water removed from the solid during drying becomes, on heating, a part of the drying medium. The purpose of the investigation was to determine the rates of drying of a granular solid in superheated steam in order to provide a quantitative basis for comparing steam and air drying. The rates of drying are expressed as heat transfer coefficients during the "constant rate" drying period for sand. The experimental work covered a temperature range 300° to 380° F., pressures from 25 to 100 pounds psi absolute, superheat to 100° F., and mass velocities from 200 to 500 lb./(hour)/(sq. foot). Drying beds one to three inches deep were used, and particle sizes included 20 to 28, 80 to 100, and 115 to 170 Tyler screen mesh. The results indicate that higher drying rates and thermal efficiencies are possible when drying with superheated steam rather than air. The use of steam must be justified by savings in operating costs as compared to greater capital expenditure. Degree of confinement of the drying medium as it passes over the material

R·P&C
VALVES
NO. 1501
150-lb.
Cast Steel
Gate Valve
Throughout Industry—It's R-P&C
for Quality Cast Steel Valves
• R-P&C Cast Steel Valves are on the job throughout industry helping to maintain uninterrupted production with their long and trouble-free service.
• Your R-P&C distributor has them—or can get them for you. Your nearest R-P&C district office will gladly furnish details about the line.
R-P & C VALVE DIVISION
AMERICAN CHAIN & CABLE
"Intrinsically Better"
READING-PRATT & CADY VALVES

NOW, AS ALWAYS

PABCO PRECISION MOLDED

85% MAGNESIA HEAT INSULATION

MODERN ENGINEERING demands precise standards of heat insulation performance. Pabco's *Precision Molded* 85% Magnesia combines the time-tested superiority of Magnesia with precision molding to give you a light weight insulation manufactured to very close tolerances.

PABCO PRECISION MOLDED INSULATIONS

APPROVED ENGINEERING SERVICE UNIT

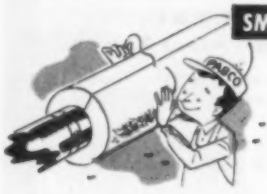
EASIER TO CUT

Pabco *Precision Molded* 85% Magnesia cuts easily and cleanly. That's because Pabco's manufacturing methods give you "ductile" strength and firmness unprecedented in the field of heat insulation materials.

BLOCKS SCORE CLEANLY

Pabco *Precision Molded* 85% Magnesia Blocks score quickly and cleanly. So important when splitting, or when preparing "hinges" for application to large rounded surfaces.

SMOOTH RIND SURFACE



Because Pabco *Precision Molded* 85% Magnesia is molded to exact final size and thickness, its surfaces are smoother with a finished "rind." Easy embedding of tie wires, a stronger surface . . . and a faster, easier clean-up!

THE DEPENDABLE STANDARD — "MODERNIZED"

quality

PABCO PRODUCTS INC.

INSULATION DIVISION

San Francisco 19 New York 16

Manufacturers of Heat Insulation Since 1920

PABCO ENGINEERING SERVICE UNITS IN ALL PRINCIPAL CITIES

Science and Technology

being dried is an important variable.

Practical Mixing Techniques for Viscous Materials. H. LESLIE BULLOCK. *Chem. Eng. Progress*, **47** (1951), pp. 397-400.

Little information is available in the literature on the mixing of viscous materials. In the present paper the author develops the fundamental mixing actions of low speed shear, wiping, smearing, folding, stretching and compressing which are applicable to viscous materials. The dual purpose of the mixing elements is described as well as the difficulty of moving the entire mass of viscous material into the active zone. The importance of the physical preparation of the materials to be mixed is stressed, and, further, that the ingredients be added in their proper order. The importance of time as an element in mixing viscous materials is stressed. All possible blending and mixing of free-flowing material should be done in light equipment under controlled conditions and the final fluxing or mixing with the viscous ingredients done in a minimum of time in heavy, high-powered equipment.

Fluid Catalyst-Gas Mixing in Commercial Equipment. J. W. ASKINS, G. P. HINDS, JR., AND F. KUNREUTHER. *Chem. Eng. Progress*, **47** (1951), pp. 401-4.

If gas mixing occurs to a large extent in commercial fluid bed catalyst reactors, this mixing should have an adverse effect on the reaction rate. It was found that there is considerable carry down of gas from the top of the bed and that this action increases as the tube diameter increases. A commercial catalytic cracking unit is an example of a large diameter fluid bed. In the experimental work gas samples were withdrawn from various points in the fluid catalyst bed of a 40-foot diameter commercial catalytic cracking regenerator. The data indicate that a high degree of gas mixing exists, since practically no variation in gas composition was found. It also seems probable that most of the gas passes through the bed in the form of bubble, rather than flowing around and fluidizing the catalyst particles. For this reason a fluid bed with a small length to diameter ratio may be an inefficient reactor as far as vapor-solid contacting is concerned. Gas mixing that exists may make such a system insufficient for effecting reactions where a high conversion is desired, or where the products formed inhibit the desired reactions.

Products: Properties, Utilization and Analysis

The Petroleum Waxes: Their Use and Evaluation for Paper Packaging. T. C. G. THORPE. *Jour. Inst. of Petroleum*, **37** (1951), pp. 275-315.

Wax was once regarded by the oil industry as one of its minor products. However, over the years the great versatility of wax has become increasingly apparent, until today it can claim to be the most versatile product of the oil industry. Candles and wax tapers are made of paraffin wax. It is widely used in wax paper wrappings, waterproofs and strengthens milk and ice cream cartons,

and used in shoe, furniture, and floor polishes. It is an important component for the waterproofing of fabrics, for impregnating matches, and for the insulation of electrical cables, condensers, and batteries. It is used to make leather goods soft and flexible. It is a major ingredient of cosmetics, hand creams, and ointments. It is used to protect steel sheets or tiny precision parts from corrosion. It prevents shrinkage and waste of fruits and vegetables. It is used for the plucking of chickens. The author reviews the usage and indicates the wax properties of greatest importance in packaging, and illustrates current practices in assessing these properties. It is desirable that the oil industry and the package manufacturer should cooperate more closely in order that tests to evaluate waxes shall be standardized to the benefit of both.

Stability Test of Motor Lubricants. D. J. W. KREULEN. *Jour. Inst. of Petroleum*, **37** (1951), pp. 316-23.

The merits of the strip test for the differentiation of motor lubricants was studied. The work was started using the apparatus developed by McKee and Fritz of the U. S. Bureau of Standards. Certain modifications were made, however. The oil in the central container was stirred. Oil was delivered by a heated capillary to insure constancy of supply. The strip was mounted in a glass cylinder to protect it from air currents and to permit analysis of the evaporated oil. Preliminary work indicated that among other things the material and surface condition of the strip influenced the result. A series of oils was studied. The statement of McKee and Fritz that the test enables distinguishing between regular, premium, and heavy duty lubricants when these oils are made from the same base stock was confirmed. Various oils were examined and a comparison was made with the I.P. oxidation test. The latter is of little value for the evaluation of modern additive-treated motor oils. The author suggests that the oxidation test be replaced by the strip test. A bibliography of six references is included.

Determination of Moisture in Gases by Automatic Dew Point Equipment. R. M. ILFELD. *Analytical Chem.*, **23** (1951), pp. 1086-9.

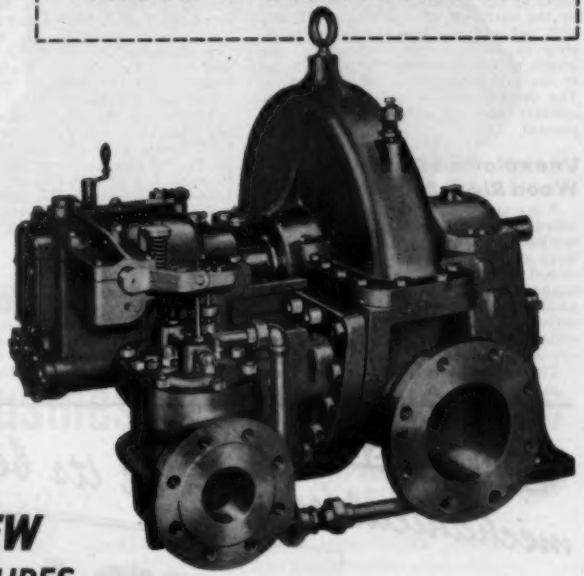
The author describes a dew point recorder and indicates some of the advantages of automatic over manual apparatus. The limitations of manually operated dew point equipment stimulated the development of the automatic dew point recorder. The instrument will record the dew point temperature of a gas over the temperature range from ambient to —90° F. The instrument comprises a mechanical refrigerator, a heater-controlled mirror assembly, and electronic controls to observe and control the amount of dew formed. The reflectance of the mirror is monitored by a photocell. The resulting signal is converted into an increase or decrease in the amount of heat supplied to the mirror. A continuous record of dew point is obtained without necessity of constant attention, and without error occasioned by different operators. The measurement is made at an equilibrium dew point temperature rather than at the transient

NEW!

MURRAY

TYPE H

MECHANICAL DRIVE SINGLE STAGE STEAM TURBINE



NEW FEATURES

- Enclosed 'shaft-through' governor
- Fast acting hand speed changer
- Improved spark proof emergency stop
- New convenient hand valve position
- Easily removed governor valve and seat
- Removable perforated metal steam strainer
- Large bearing oil reservoirs
- Large finned-tube oil coolers
- Magnetic oil-drain plugs
- New type split oil rings
- Corrosion resistant carbon packing cases
- Chrome plated shaft under carbon rings

Combining a host of new improvements plus time tested features, the Murray Type H offers extra-value in a medium size machine. With a range of 50-200 H.P., depending upon speed and steam conditions, it is offered with either a 16" or 20" diameter wheel. 3" or 4" steam inlet sizes available. Steam conditions up to 600 lbs., 750° and back pressures up to 150 lbs. can be used.

Write today for full details.

MURRAY IRON WORKS COMPANY

BURLINGTON, IOWA

Builders of Steam Power Equipment for Three Quarters of a Century

temperature often used in manual observation. The instrument is designed for normal service in industrial plant usage.

Rapid Estimation of Small Amounts of Ethylene in Air. Portable Instrument. FRED STITT, A. H. TJENSVOLD, AND YOSHIO TOMIMATSU. *Analytical Chem.*, **23** (1951), pp. 1138-41.

A simple method for estimating small concentrations of ethylene in air, such as 5 to 200 p.p.m., is described. A fixed volume of gaseous sample is passed successively over granular red mercuric oxide at 285° C. and a strip of sensitized paper at 125° C. Mercury vapor formed by the oxidation of the ethylene reacts with red selenium deposited in the paper strip to form a black coloration, the length of which is directly proportional to the ethylene content of the sample. The determinations require only a few minutes with an error of less than 10 percent.

Unexplained Explosion at Wood River Being Probed

A fire and explosion of unknown origin killed thirteen and injured 20 other workers engaged in special night operations at Shell Oil Company's refinery at Wood River, Ill. Static electricity was suggested as a possible cause of the explosion which caused property damage estimated at $100,000. Shell officials stated definitely that no equipment failure was involved.

The explosion occurred at one of the large oil cracking units where a special night crew of about 40 men was giving a Dubbs cracking unit a routine cleaning. Spectators said the flash fire following the explosion shot flames high into the air.

Not damaged seriously, production of the cracking unit will temporarily be reduced from 120,000 barrels by 7 or 8000 barrels daily.

American Petrochemicals Announces Executive Panel

W. Alton Jones, president of Cities Service Company, was elected chairman of the American Petrochemical Corporation when the newly organized company named its officers. The company is equally owned by Cities Service and Firestone Tire Rubber Company.

Harvey S. Firestone, Jr., was named vice chairman; W. D. Gohr, Firestone, president; George L. Mateer, Cities Service, and Dr. John N. Street, Firestone, vice presidents.

Members of the board, including Jones and Firestone, are: Burl S. Watson, H. L. O'Brien, C. E. Weger, Mateer and W. H. Price of Cities Service, and L. R. Jackson, J. E. Trainer, Gohr, Street and Roger S. Firestone of Firestone.

American Petrochemical Corporation will build a plant at Lake Charles, La.

Ethyl Loses PR Head

Ralph C. Champlin, 1948 Oil Industry Information Committee chairman, has been named vice president in charge of public relations and advertising for the Pennsylvania Railroad. He was public relations director for Ethyl since 1939.

Oil Coop Leaders Hear Cowden in Copenhagen

Oil cooperative associations were urged to establish a more powerful organization in international trade by Howard A. Cowden, president and general manager of the Consumers Cooperative Association in Kansas City. Cowden spoke before the International Oil Cooperative Petroleum Association leaders in Copenhagen.

"The ultimate consumers on different continents are well acquainted with oil cooperatives and are demanding their continuation on a broader scale," said Cowden. Rendering service in the petroleum field in competition to monopolies is a real challenge and the service must be carried forward to a strong international organization, he said.

Dr. Wilson Criticizes Interior's Synthetic Plan

The Interior Department plan for a government-subsidized synthetic fuels project was attacked by Dr. Robert E. Wilson, Standard Oil Company (Indiana) board chairman, who cited the move as another instance of government encroachment into private enterprise. He criticized the $400 million proposal on grounds that the critical shortage of steel made the plan uneconomic when, "for half the steel and half the money, an equal quantity of gasoline and other fuels could be obtained from petroleum."

He outlined a six point program that called upon all U. S. industry to shake off governmental crutches and to stand or fall on its own ability to operate.

TEL Manufacture Capacity Dependent on Foreign Lead

Continued production of tetraethyl lead at capacity levels depends "almost completely upon the ability and willingness of manufacturers to purchase foreign lead," predicts Bruce K. Brown, PAD deputy. A cut in TEL production would have to be borne by civilian gasolines, and PAD, while following the situation closely, hopes that the agency will not have to take extraordinary actions.

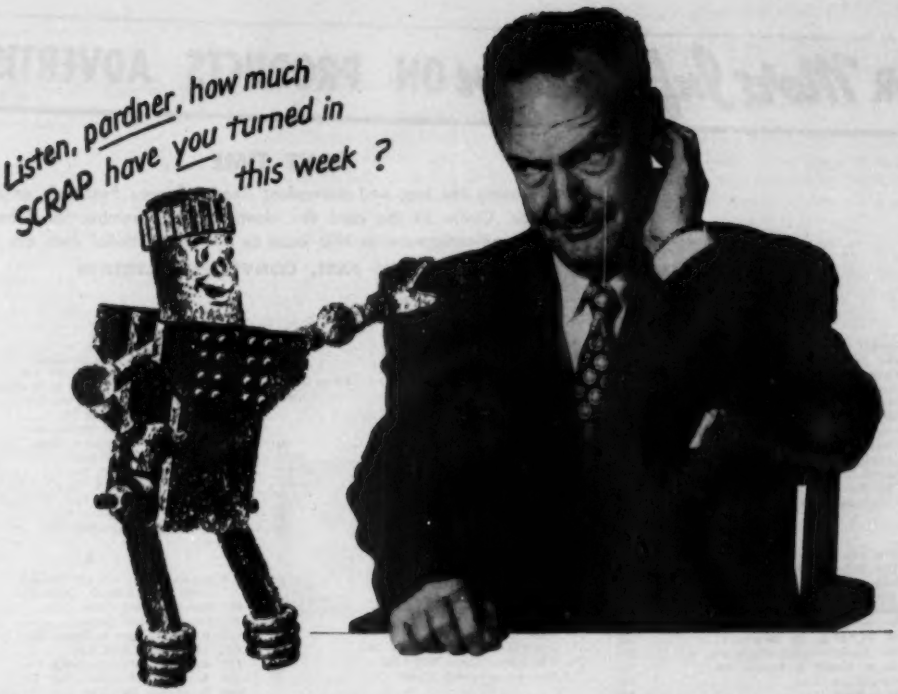
Ethyl and Du Pont, major TEL manufacturers, have been forced to purchase lead in the higher priced foreign markets and report they "are just getting by" from month to month.

Freedom-Valvoline Elects Three New Executives

Earl M. Craig, formerly president of Freedom-Valvoline Oil Company, was elected board chairman at a recent election. Everett F. Wells, who succeeds him as president, will continue residence in Ashland, Ky., where he is executive vice president of Ashland Oil & Refining Company. Formerly vice president in charge of sales, Harry J. Johnston was elected executive vice president of the company.

Hardy Elected by Aramco

Norman Hardy has been elected vice president of Arabian American Oil Company and will reside in Dhahran, Saudi Arabia. Prior to joining Aramco last February, Hardy was president of Richmond Petroleum Corporation, a subsidiary of Standard Oil Company of California.



Today, the steel business is your business

—*it needs all your SCRAP, Now!*

SUPPOSE that every steel user were suddenly told that he had to turn in a half-ton of scrap before he could get a ton of steel. It would start the most gosh-almighty treasure hunt for scrap that ever happened.

In effect, this "no-scrap, no-steel" situation virtually exists. For without *all* the scrap that industry can search out and start on its way to the mills, steel production will surely drop. It's as serious as that.

More scrap is urgently needed. Today the mills are turning out more steel than ever before. But they're scraping the bottom of the barrel as far as scrap is concerned. Defense and domestic demands for steel simply cannot be met unless at least 100,000 tons of "purchased" scrap roll into the furnaces—*every day.*

The bulk of this scrap must come from industry. That's why we're asking for your all-out help. That's why it's so important that you make the drive for scrap part of your daily operations. Make it your business to encourage every employee to report any obsolete, broken or worn-out machinery, tool or equipment that has seen its day. From this dormant "junk" must come the heavy melting scrap that the mills need most. Don't let your scrap lie idle; send it on its way. How about it, pardner?

You'll find your local scrap dealers listed in the yellow pages of the phone directory.

This page would ordinarily be used to tell you about

U·S·S STAINLESS STEEL

but, because without SCRAP we cannot produce steel, we are asking instead for your all-out help in getting more SCRAP to the mills.

AMERICAN STEEL & WIRE COMPANY, CLEVELAND
COLUMBIA STEEL COMPANY, SAN FRANCISCO · NATIONAL TUBE COMPANY, PITTSBURGH
TENNESSEE COAL, IRON & RAILROAD COMPANY, BIRMINGHAM · UNITED STATES STEEL COMPANY, PITTSBURGH
UNITED STATES STEEL SUPPLY COMPANY, WAREHOUSE DISTRIBUTORS, COAST-TO-COAST
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS

1-1328

UNITED STATES STEEL

FOR *More Information* ON PRODUCTS ADVERTISED

SAVE TIME . . .

By using the free and convenient Reader Service Postcards on opposite page. Circle on the card the identifying key number listed below for each advertisement in this issue on which additional data are desired.

IT'S FAST, CONVENIENT, CERTAIN

A

(A1) Aerofin Corp. 216
(A2) The Air Preheater Corp. 2
(A3) Airetool Manufacturing Co. 210
(A4) Alan Wood Steel Co. 208
(A5) Aluminum Company of America 57
(A6) Aluminum Company of America 211
(A7) American Brass Co. 83
(A8) American Locomotive Co. 27
(A9) American Meter Co. 75
(B1) American Steel & Wire Co. 191
(B2) The Anonia Co. 47
(B3) Armstrong Machine Works 5

B

(B4) The Babcock & Wilcox Co. 88-89
(B5) The Babcock & Wilcox Co. 92
(B6) Badger Process Division Stone & Webster Engr. Corp. 44-45
(B7) Baldwin-Hill Co. 231
(B8) Beaver Pipe Tools, Inc. 240
(B9) W. H. & L. D. Betz 222
(C1) Big Three Welding Equipment Co. 240
(C2) Black, Sivalls & Bryson, Inc. 185
(C3) Blaw-Knox Co. 20
(C4) Blaw-Knox Co. 182
(C5) Blaw-Knox Co. 235
(C6) Bridgeport Brass Co. 91
(C7) The Bristol Co. 18
(C8) The Brown Fintube Co. 204
(C9) Bryon Jackson Co. 9

C

(D1) Cameron Iron Works, Inc. 176
(D2) The Chapman Valve Mfg. Co. 55
(D3) Charlie's Machine Works 236
(D4) Chase Brass & Copper Co., Inc. 79
(D5) Chemical Construction Corp. 62
(D6) Chicago Bridge & Iron Co. 64
(D7) Chicago-Wilcox Mfg. Co. 236
(D8) Clark Bros. Co. 76-77
(D9) The Clark Manufacturing Co. 170
(E1) Coast Paint & Lacquer Co. 219
(E2) The Continental Supply Co. ..... Insert 64
(E3) The Cooper-Bessemer Corp. 167
(E4) Corning Glass Works 232
(E5) Crane Co. 56
(E6) Croll-Reynolds Co. 221

D

(E7) The Davison Chemical Corp. 88
(E8) Dean Brothers Pumps, Inc. 206
(E9) Dempster Brothers, Inc. 58
(F1) Dollinger Corp. 21
(F2) Dowell Inc. 66
(F3) E. I. du Pont de Nemours & Co. 70
(F4) E. I. du Pont de Nemours & Co. ..... Insert 160-161
(F5) Durametallic Corp. 190

E

(F6) The Eagle-Picher Co. 34-35
(F7) Earl Paint Corp. 83
(F8) Electric Steel Foundry 171
(F9) Elliott Co. 50
(G1) Elliott Co. 163
(G2) Engineers & Fabricators, Inc. 40
(G3) Enjay Co. 65
(G4) Ethyl Corp. ..... Insert 224-225

F

(G5) Fisher Governor Co. 54
(G6) Flint Steel Corp. 214
(G7) The Fluor Corp. 236
(G8) Foster Wheeler Corp. ..... Insert 32-33
(G9) The Foxboro Co. 202

G

(H1) The Garlock Packing Co. 31
(H2) General Electric Co. 12-13
(H3) General Electric Co. 100-101
(H4) A. J. Gerrard & Co. 235
(H5) Gilbert & Barker Mfg. Co. 59
(H6) The Girdler Corp. 11
(H7) A. P. Green Fire Brick Co. 63
(H8) Grinnell Co. 19

H

(J1) Hudson Engineering Corp. 87

I

(J2) Ingersoll-Rand Co. 30
(J3) International Engineering, Inc. 174
(J4) The International Nickel Co. 7
(J5) The International Nickel Co. 99

J

(J6) The C. O. Jelliff Mfg. Corp. 234
(J7) Johns-Manville 16
(J8) Johns-Manville 104

K

(J9) Keasbey & Mattison Co. 32
(K1) The M. W. Kellogg Co. ..... Insert 96-97
(K2) Kerotest Manufacturing Co. 26
(K3) Koch Engineering Co. 160

L

(K4) Layne & Bowler, Inc. 223
(K5) Leeds & Northrup Co. 8
(K6) Warner Lewis Co. 236
(K7) The Lummus Co. 198

M

(K8) Manning, Maxwell & Moore, Inc. 200
(K9) The Marley Co. 103
(L1) Mason-Neilan Regulator Co. 213
(L2) The Master Electric Co. 6
(L3) A. Y. McDonald Mfg. Co. ..... IV Cover
(L4) Arthur G. McKee & Co. 165
(L5) McNamar Boiler & Tank Co. 228
(L6) Metal Textile Corp. 225
(L7) Minneapolis-Honeywell Regulator Co. 36-37
(L8) Mixing Equipment Co. 194
(L9) Monsanto Chemical Co. 51
(M1) Mundet Cork Corp. 212
(M2) Murray Iron Works Co. 189

N

(M3) The Natasco Co. 220
(M4) National Airoil Burner Co. 221
(M5) National Carbon Co. 180
(M6) National Lead Co. 209
(M7) W. H. Nicholson & Co. 226

O

(M8) Oakite Products, Inc. 223
(M9) The Ohio Steel Foundry Co. 186
(N1) Oil Well Supply Co. 80
(N2) Orbit Valve Co. 179

P

(N3) Pabco Products, Inc. 188
(N4) Page Steel & Wire Division American Chain & Cable Co. 177
(N5) The Patterson Foundry & Machine Co. 227
(N6) Petro-Chem Development Co. 60
(N7) Petroleum Rectifying Co. 39
(N8) Philadelphia Gear Works, Inc. 175
(N9) Pittsburgh Lectrodryer Corp. 207
(P1) The Wm. Powell Co. 14
(P2) The Pressed Steel Co. 15
(P3) J. F. Pritchard & Co. 217
(P4) J. F. Pritchard & Co. 230
(P5) Procon, Incorporated 24-25
(P6) Pyrene Manufacturing Co. 178

R

(P7) Reading-Pratt & Cady Division American Chain & Cable Co. 187
(P8) Republic Steel Corp. 22
(P9) Republic Steel Corp. 172
(Q1) Revere Copper & Brass, Inc. 239
(Q2) The Ridge Tool Co. 184
(Q3) Rochester Manufacturing Co. 229
(Q4) Rockwell Manufacturing Co. 28-29
(Q5) Rockwood Sprinkler Co. 61
(Q6) Roots-Connersville Blower Corp. 173

S

(Q7) Scovill Manufacturing Co. 17
(Q8) Sealol Corp. 229
(Q9) Shand & Jurs Co. ..... Insert 65
(R1) Shell Chemical Corp. 46-49
(R2) Shell Development Co. 218
(R3) Sier-Bath Gear & Pump Co. 224
(R4) Sims Pump Valve Co. 234
(R5) A. O. Smith Corp. 232
(R6) Struthers Wells Corp. 43
(R7) Sun Shipbuilding & Dry Dock Co. 42
(R8) Superior Manufacturing Co. 240

T

(R9) Taylor Forge & Pipe Works 23
(S1) The Terry Steam Turbine Co. 38
(S2) The Timken Roller Bearing Co. 4

U

(S3) Union Asbestos & Rubber Co. 52

V

(S4) The Vapor Recovery Systems Co. 196
(S5) Henry Vogt Machine Co. 46
(S6) Vulcan Copper & Supply Co. 72

W

(S7) Wallace & Tiernan Products, Inc. 183
(S8) Walworth Co. 33
(S9) Warren Petroleum Corp. ..... I Cover
(T1) Western Supply Co. 33
(T2) Whiton Machine Co. 235
(T3) Wolverine Tube Division Calumet & Hecla Consolidated Copper Co. 10
(T4) Worthington Pump & Machinery Corp 41
(T5) Wyatt Metal & Boiler Works ..... III Cover

Y

(T6) Yarnall-Waring Co. ..... II Cover
(T7) Young Radiator Co. 5

Use the Handy Postcards ⟶

New Catalogs AND EQUIPMENT LITERATURE

For copies of the catalogs and new equipment literature listed, use one of the convenient Reader Service Postcards on this page. Just circle the number on the card corresponding to the number of the item in which you are interested.

Potentiometers

Electronik Potentiometers, Catalog 15-15, is the latest publication by Minneapolis-Honeywell, Brown Instruments, Station 40, Wayne and Windrim Avenues, Philadelphia 44. Contents table lists sections on operation, construction, specifications, control forms, electronic proportional relays, control systems, style selection, charts and scales, drilling dimensions, switches, thermocouples, radiamatic assemblies, motors and motorized valves, catalog listing.

Circle No. 1 on Postcard

Oil and Water Cooler

A new design of oil and water cooler is described in a bulletin published by Griscom-Russel Company, 285 Madison Avenue, New York 17. This L.K.-Fin cooler, is distinguished by the use of helically-finned heat transfer elements instead of conventional bare tubes. Bulletin 1020 explains how L.K.-Fin elements "provide a lighter, more compact and less costly unit for a given cooling service," and diagrams show comparisons of length and number of tubes and size of units for equivalent heat transfer surface.

Circle No. 2 on Postcard

Alkalies Bulletin

Solvay Sales Division, Allied Chemical & Dye Corporation, has published a new, revised edition of their Technical & Engineering Service Bulletin Number 9, "The Analysis of Alkalies."

Circle No. 3 on Postcard

Steel Flooring

"Versatile Open Steel Flooring" is a recent brochure published by the Open Steel Flooring Institute, Inc. Photographs show many and varied possibilities for using the steel grating. It explains types and features of open steel flooring and specifications for insuring quality open steel flooring and its proper installation.

Circle No. 4 on Postcard

Flow Signal Transmitter

The Hagan Corporation Flow Signal Transmitter is described in a new company bulletin. This pneumatically operated pressure-differential measuring unit transmits proportional signals to remote recording or indicating instruments, or to automatic control elements. The signals may be linear with flow or linear with pressure differential.

Circle No. 5 on Postcard

USE THESE CARDS
To Get
COPIES OF CATALOGS
And for More
Information on
NEW EQUIPMENT
ADVERTISED PRODUCTS

EASY TO USE . . . FREE

Circle on one of the cards at right the identifying numbers of each new equipment and catalog item or advertised product on which you want more information. Print your name and address plainly. Tear out and mail card. That's all there is to it. No postage is required if card is mailed in U.S.A. your request will be forwarded promptly to the company concerned, and the reply will come direct to you.

Postage Will be Paid by Gulf Publishing Company

No Postage Stamp Necessary If Mailed in the United States

BUSINESS REPLY CARD

First Class Permit No. 7 (Sec. 34.9, P. L. & R.) Houston, Texas

PETROLEUM
REFINER

BOX 2608

HOUSTON 1, TEXAS, U. S. A.

PETROLEUM REFINER Reader Service Postcard—October, 1951, Issue

EDITORIAL ITEMS—Circle item numbers on which more information desired:

1	4	7	10	13	16	19	22	25	28	31	34	37	40	43	46	49	52	55	58	61	64		
2	5	8	11	14	17	20	23	26	29	32	35	38	41	44	47	50	53	56	59	62	65		
3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60	63	66		

ADVERTISEMENTS—Circle key num[illegible] or of ad for more product information:

A1	B1	C1	D1	E1	F1	G1	H1	J1	K1	L1	M1	N1	P1	Q1	R1	S1	T1						
A2	B2	C2	D2	E2	F2	G2	H2	J2	K2	L2	M2	N2	P2	Q2	R2	S2	T2						
A3	B3	C3	D3	E3	F3	G3	H3	J3	K3	L3	M3	N3	P3	Q3	R3	S3	T3						
A4	B4	C4	D4	E4	F4	G4	H4	J4	K4	L4	M4	N4	P4	Q4	R4	S4	T4						
A5	B5	C5	D5	E5	F5	G5	H5	J5	K5	L5	M5	N5	P5	Q5	R5	S5	T5						
A6	B6	C6	D6	E6	F6	G6	H6	J6	K6	L6	M6	N6	P6	Q6	R6	S6	T6						
A7	B7	C7	D7	E7	F7	G7	H7	J7	K7	L7	M7	N7	P7	Q7	R7	S7	T7						
A8	B8	C8	D8	E8	F8	G8	H8	J8	K8	L8	M8	N8	P8	Q8	R8	S8	T8						
A9	B9	C9	D9	E9	F9	G9	H9	J9	K9	L9	M9	N9	P9	Q9	R9	S9	T9						

Name (Please Print)_____

Company_____ Position_____

Address_____

MAIL IT NOW . . . *CARD EXPIRES JANUARY 10, 1952

New Catalogs AND EQUIPMENT LITERATURE

Use one of the free and convenient Reader Service Postcards on this page to request copies of the catalogs in which you are interested.

Storage Tank Safety Rules

"Tank Talk" a booklet produced by Petroleum Chemicals Division, Du Pont Company, Wilmington, Del., is directed to stimulate safety among men who enter and clean gasoline storage tanks. It is concerned primarily with safe procedures for entering leaded gasoline storage tanks, particularly concerning safe methods for removal and disposal of sludge. The book is pocket size and gives cartoon treatment amplified by text.

Circle No. 6 on Postcard

Projects Assistance

A booklet defining Petrocarbon Limited services for projects in the field of oil refining and chemicals from oil and other raw materials is now available. Petrocarbon offers design, development, engineering and building services throughout the world and "Petrocarbon Services" explains company activities in research, planning, process design, etc., as well as related services.

Circle No. 7 on Postcard

Temperature Data

Data from the files of The International Nickel Company, Inc., on high temperature applications of metals and alloys is easily secured from the company if inquiry is filed on a special Work Sheet prepared by the Development and Research Division for this use.

Circle No. 8 on Postcard

Packings Bulletin

The Packing Division of Raybestos-Manhattan, Inc., has published a bulletin describing R/M Braided and Twisted Asbestos Packings. Service recommendations, sizes, specifications and weights are included.

Circle No. 9 on Postcard

Pneumatic Operator

An illustrated bulletin describing the new Cono Rotomotor manufactured by Conoflow Corporation contains information on the "only" completely pneumatic gear-driven operator for throttling control service. Applicable to heavy duty services, Bulletin C-1 contains complete engineering data.

Circle No. 10 on Postcard

Blowers & Compressors

Comprehensive data on three types of De Laval Steam Turbine Company centrifugal blowers and compressors is available in booklet Number 0500. The types are: multistage; single stage, end suction; and single stage double suction. Application data, design, drives and engineering data are included.

Circle No. 11 on Postcard

Autronic Control

The Swartwout Company has published bulletin A-701 describing the new Swartwout Autronic Control System. It is said to be the first miniature all-electronic system for controlling pressure, temperature, flow and level. It is for use in chemical processing plants, refineries, etc.

Circle No. 12 on Postcard

(More Literature Items on Pages 193, 195, 197, 199, 201)

PETROLEUM REFINER Reader Service Postcard—October, 1951, Issue*

EDITORIAL ITEMS—Circle item numbers on which more information desired:

1	4	7	10	13	16	19	22	25	28	31	34	37	40	43	46	49	52	55	58	61	64
2	5	8	11	14	17	20	23	26	29	32	35	38	41	44	47	50	53	56	59	62	65
3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60	63	66

ADVERTISEMENTS—Circle key number of ad for more product information:

A1	B1	C1	D1	E1	F1	G1	H1	J1	K1	L1	M1	N1	P1	Q1	R1	S1	T1
A2	B2	C2	D2	E2	F2	G2	H2	J2	K2	L2	M2	N2	P2	Q2	R2	S2	T2
A3	B3	C3	D3	E3	F3	G3	H3	J3	K3	L3	M3	N3	P3	Q3	R3	S3	T3
A4	B4	C4	D4	E4	F4	G4	H4	J4	K4	L4	M4	N4	P4	Q4	R4	S4	T4
A5	B5	C5	D5	E5	F5	G5	H5	J5	K5	L5	M5	N5	P5	Q5	R5	S5	T5
A6	B6	C6	D6	E6	F6	G6	H6	J6	K6	L6	M6	N6	P6	Q6	R6	S6	T6
A7	B7	C7	D7	E7	F7	G7	H7	J7	K7	L7	M7	N7	P7	Q7	R7	S7	T7
A8	B8	C8	D8	E8	F8	G8	H8	J8	K8	L8	M8	N8	P8	Q8	R8	S8	T8
A9	B9	C9	D9	E9	F9	G9	H9	J9	K9	L9	M9	N9	P9	Q9	R9	S9	T9

Name (Please Print)_____

Company_____ Position_____

Address_____

MAIL IT NOW . . . *CARD EXPIRES JANUARY 10, 1952

Postage Will be Paid by Gulf Publishing Company

No Postage Stamp Necessary If Mailed in the United States

BUSINESS REPLY CARD

First Class Permit No. 7 (Sec. 34.9, P. L. & R.) Houston, Texas

PETROLEUM
REFINER

BOX 2608

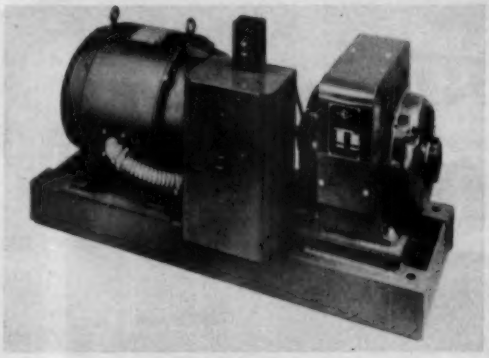
HOUSTON 1, TEXAS, U. S. A.

USE THESE CARDS To Get COPIES OF CATALOGS And for More Information on NEW EQUIPMENT ADVERTISED PRODUCTS

NEW EQUIPMENT and Manufacturers' Literature

KEEP INFORMED by requesting additional information on new equipment and services described here. SAVE TIME by using the Reader Service Postcards on opposite page. Circle number on card corresponding to the number listed at the end of each new equipment item on which you desire additional information.

Hi-Cycle Motor Generator



Used to convert 60 cycle current to 180 cycle and 360 cycle frequencies, this new mono-coil high frequency motor generator set is built by Electric-Machinery Manufacturing Company. The unit is best utilized in plants using high-cycle automatic electric hand tools such as grinders and buffers. These sets are self exciting and have built in voltage regulation which automatically compensates for fluctuations in voltage to the load. This compact, easily installed unit shown is 6 KW, with 360 cycles at 3600 rpm.

Circle No. 13 on Postcard

Pressure Transmitters

Engineering Data Folders illustrate and describe pressure measurement transmitters including the Bourdon Tube Pressure Transmitter, all manufactured by Automatic Temperature Control Company, Inc. Folders include application data, operational features, available ranges, wiring and case diagrams.

Circle No. 14 on Postcard

Desiccator

Made of transparent glass with a crew-cap lid, the new desiccator made by Bethlehem Apparatus Company, Inc., is known as the Bethlehem Dri-Jar. Unique features include a cloverleaf pattern cut into the shelf. The petals formed can be adjusted with fingertip pressure to secure the proper size hole for each crucible. Shelves are adjustable because of three steel ribs containing calibrated slots attached to the lid which permit change of the three-inch diameter shelves. The screw-type cap prevents the lid from popping off when hot crucibles are placed in the unit. The jars measure 3½x6⅝ inches.

Circle No. 15 on Postcard

Ratio Controller

Unusual features of Fischer & Porter Company's Automatic Flow Ratio Control Systems is described in Catalog 53. The principle of operation is described as well as the fundamental reasons for improved ratio control. In the petroleum industry the ratio controller is handling such jobs as production of LPG gas, the refining of white oil, and the blending of heavy fuel or road oil. In addition to specific information on the Controller, the catalog lists other available publications.

Circle No. 16 on Postcard

High Pressure Regulator

A new 6-curve plano plastic lens for plications, operating principles and features of Grove Powreactor Dome regulators has been released by the Grove Regulator Company. These regulators are used extensively for controlling gas, liquids and air at pressures up to 6000 pounds at temperatures up to 150° F. Connection sizes range from ¼ to 2 inches. Fully self-contained, these regulators automatically and accurately keep delivery pressures at the present pressure by instantly reacting to offset any sudden or large surges in the flow.

Circle No. 17 on Postcard

Vertical Induction Motors

Data on ratings, construction and types of large Allis-Chalmers vertical induction motors are contained in a new bulletin released by the company. Ratings are available from 60 hp. at 200 rpm., upwards.

Circle No. 18 on Postcard

Surface Exchangers

Vogt Scraped Surface Exchangers is the name of Bulletin PE-1 published by Henry Vogt Machine Company. The bulletin describes the patented scraper element feature for inner pipe surfaces to prevent fouling. The two basic types of scraped surface equipment, the Double Pipe Type and the Shell and Pipe Type, is described. Schematic diagrams portray details of construction, while text and photo illustrate use of the equipment in industry.

Circle No. 19 on Postcard

Welding Electrodes

An International Nickel bulletin by three welding specialists of the Industrial Test Laboratory, Philadelphia Naval Shipyard, summarizes results obtained with commercially available rods that produced, without preheat in high strength steels, crack-free welds. The welded areas consistently exceeded 11,000 psi. yield strength with maximum ductility.

Circle No. 20 on Postcard

Air Vent Pouring Spout

A safety air vent pouring spout that fits any size carboy and assures smooth even flow of acid without spurts or splashes is made by General Scientific Equipment Company. Made of a special acid-resistant rubber and plastic tubing for longer life, the spout has a capacity of five gallons per minute. Because of the steady flow, acid cannot spill or splash, and pumping or siphoning is unnecessary.

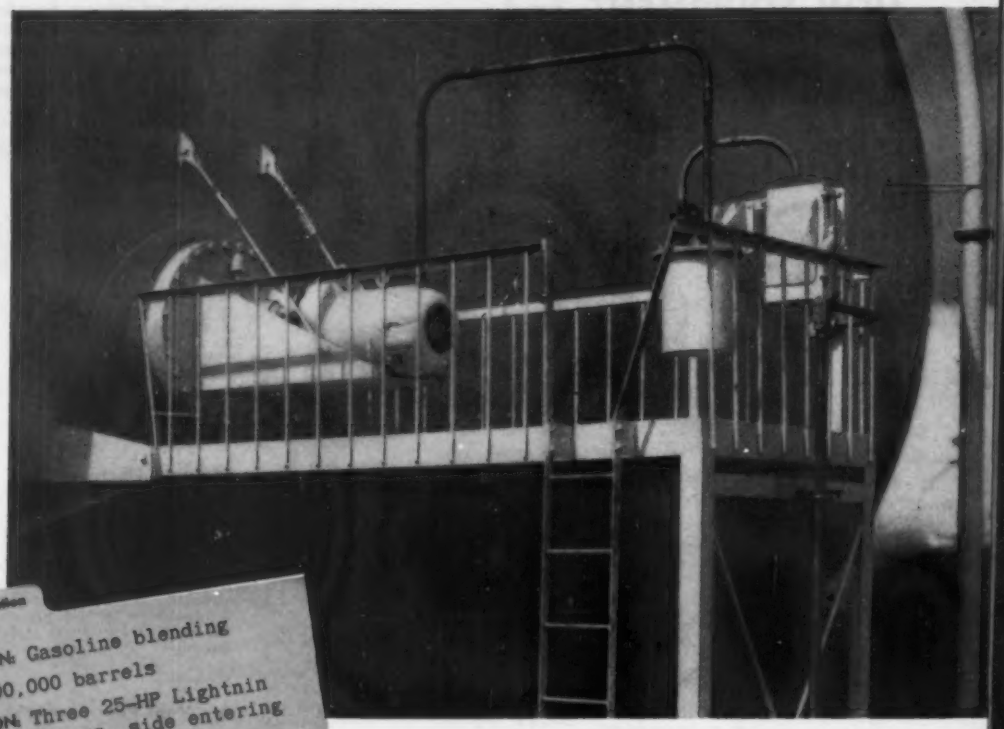
Circle No. 21 on Postcard

Fluid Mixing Unit

Abbé Dispersall Mixer for dispersing, emulsifying and milling in one operation is described and illustrated in Abbé Engineering Company, Catalog Number 68. The mixer is applicable to all kinds of fluid mixes from thin slurries to pastes.

Circle No. 22 on Postcard

MORE TANKFULS *from the* same tanks



LIGHTNIN Installation #947

OPERATION: Gasoline blending

TANK: 100,000 barrels

AGITATION: Three 25-HP Lightnin Mixers, side entering propeller type.

TOTAL INSTALLED HORSEPOWER: 75

BLENDING TIME: Less than 2 hours

Here's proof!

Yes, Lightnin Mixers give you *more product* from your present plant . . . boost your operating profit by speeding up the important mixing-blending operations . . . give you as much as *30% more capacity* with the same tankage.

The record speaks for itself. Lightnin Mixers have been *top choice* with refiners for more than 20 years. Got a mixing or blending problem? Call in your MIXCO representative, or write us today!

MANUFACTURERS OF

Lightnin® Mixers

LIGHTNIN PORTABLE MIXERS
World's largest-selling line. Electric or air motor, direct or gear drive. Sizes ½ to 3 HP.

LIGHTNIN SIDE ENTERING MIXERS
For tanks up to 5 million gallons. Gear motor or V-belt drive; motorless types. Sizes 1 to 25 HP.

LIGHTNIN TOP ENTERING AGITATORS
Turbine, propeller and paddle types. For open or closed tanks. 16 speeds available in new heavy duty drive. Sizes ½ to 500 HP.

A COMPLETE LINE . . . UNEXCELLED TECHNOLOGY

MIXING EQUIPMENT Co., Inc.

(MIXCO)

164 Mt. Read Blvd., Rochester 11, N. Y.

In Canada: William & J. G. Greey, Ltd., Toronto

Please send me the literature checked:

- ☐ B-76 Side Entering Mixers
- ☐ B-78 Top Entering Mixers (Propeller Type)
- ☐ B-89 Top Entering Mixers (Turbine and Paddle Type)
- ☐ DH-50 Laboratory Mixers
- ☐ B-52 Condensed Catalog showing complete line
- ☐ B-75 Portable Mixers (Electric and Air Driven)

Name_____

Title_____

Company_____

Address_____

City_____ Zone____ State_____

Process Control Device

Minneapolis-Honeywell Regulator Company has developed an instrument that provides sensitive, instantaneous and accurate control of flow, temperature, pressure, liquid level and other industrial process variables. The Tel-O-Set controller is described as the latest component in a series of new devices designed to improve process control. It was developed for use with the differential converter, the Tel-O-Set indicator and the Tel-O-Set recorder and is said to be an easily installed, compact unit. It operates on a pneumatic balance principle which eliminates friction and lost motion. Made in two types, one with fixed proportional band, the other with an adjustable proportional band, the units are constructed of a number of coded, interchangeable sections separated by diaphragms.

Circle No. 23 on Postcard

Meter-Relay Controls

A late bulletin by Assembly Products, Inc., describes the use of electro-magnetic locking contacts in the Simplytrol line of automatic contact meter-relay controls. Also described are the controlling pyrometers and accessory equipment.

Circle No. 24 on Postcard

Safety Equipment

A new line of Bureau of Mines approved Chemical Cartridge Respirators is manufactured by Willson Products, Inc., manufacturers of personal safety equipment. Known as the "800" Series, the line includes styles for protection against low concentrations of many common industrial gases and vapors, as well as metal fumes, mists and dusts. Principal feature of the new respirator is a newly designed facepiece with feathered rolled edges for snug, comfortable fit. The exhalation valve is positioned to minimize possibility of dust interfering with normal operation.

Circle No. 25 on Postcard

Welding Unit

"Fillerweld," a new product designed to speed alloy-metal welding on applications where filler-metal must be added, was recently marketed by General Electric. Used with gas-shielded arc welders, Fillerweld allows the operator to control the continuous flow of filler-metal automatically by means of a finger switch mounted on the torch. It consists of two main elements, the torch or "gun," and a mechanical power unit. The gun is basically a manual water-cooled Inert-Arc tungsten holder to which a control switch has been added, and a gear assembly for pulling the filler-metal from the spool to the arc through the gun. Rated at 250 amperes, the gun accommodates tungsten from 0.040 to 5/32 inch in diameter and up to seven inches long.

Circle No. 26 on Postcard

Spur-Gear

The Challenger, a spur-gear hoist manufactured by Coffing Hoist Company, weighs only 39½ pounds and is easily moved from place to place. Formed steel plate in the housing, is said by the manufacturer to add strength and unusual resistance, while a laminated back plate provides great rigidity. The back plate and all load holding parts are made of high strength steel. It can be easily disassembled in minutes with simple tools according to the manufacturer. The company advises long life and high efficiency is achieved for the Challenger because it is sealed in lubricant.

Circle No. 27 on Postcard

Sulfur Recovery

General Industrial Development Corporation is presently marketing an "improved" Claus process for recovery of elemental sulfur from hydrogen sulfide. The process is recommended for use with gases having more than ten percent hydrogen sulfide by volume. Special regulating organs behind the waste heat boiler, which in turn is an integral part of the combustion furnace, enable a better regulation of temperature in the catalytic converters.

Circle No. 28 on Postcard

Pressure Switches

To promote a better understanding of the complex problems involved in the proper application of vital electric-hydraulic links, Barksdale Valves has published a manual on Pressure Switches. A glossary of terms, tabulation of available units based on function and pressure or vacuum range, diagrams for circuit detailing, etc., are included in the contents.

Circle No. 29 on Postcard

Air Hammer

Designed to perform medium-heavy duty work in general shop and maintenance operation, the new Model G-200 Air Hammer, manufactured by the Pneumatic Tool Division of Salsbury Corporation, only weighs slightly over two pounds. Working at 120 psi this Air Hammer strikes up to 6000 blows per minute, with maximum force, or may be metered to any lower speed or striking power by means of a simple finger trigger action. Illustration shows the Air Hammer using a curved shank chisel Number 28 with 1½ inch face to remove welding spatter on truck body construction work. Photo courtesy Standard Auto Body Company, Los Angeles.

Circle No. 30 on Postcard

Thread Restorer

Bonney Forge & Tool Works claims it is easy to rechase battered or damaged threads by using the latest Bonney TR7 illustrated herewith. The set consists of eight sizes of restorers, ranging from a bolt diameter of one-quarter inch with 28 threads per inch, to a three-quarters inch bolt diameter with 16 threads per inch.

Bonney Tool Catalog features three complete Diesel Locomotive Sets: for machinists, electricians, and for pipe fitters. The machinist's set contains 55 tools which will handle practically every kind of service job. The 51 essential tools for electrical work includes the new 4080 half-inch drive planetary ratchet. The pipe fitter's set contains all necessary box end, open end and flare nut wrenches, etc. Packaged in metal boxes.

Circle No. 31 on Postcard

Steel Tubing

Technical data on tubing for the petroleum and chemical processing industries is given in a bulletin published by The Babcock & Wilcox Tube Company. Bulletin TA 1559 contains analyses and tables of physical and mechanical properties as well as application data for 20 popular carbon, alloy and stainless tubing steels. Used where temperature, pressure, sanitation, or corrosive environments are important considerations.

Circle No. 32 on Postcard

WHEN STORING FLAMMABLE LIQUIDS

IT PAYS TO BE

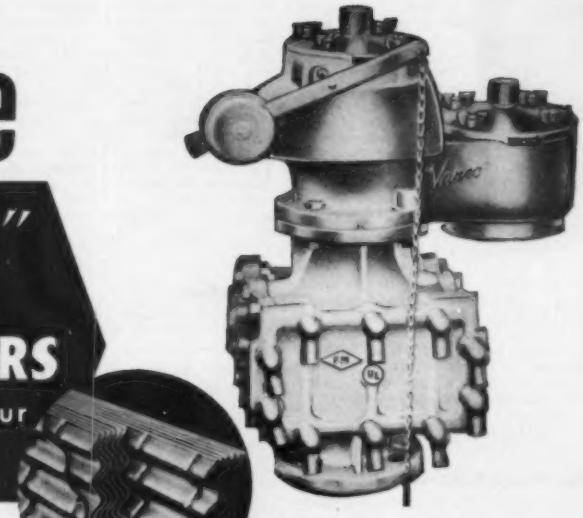
EXTRA **Safe**

" WITH *Varec*"

FLAME ARRESTERS

in combination with your

VENT VALVES



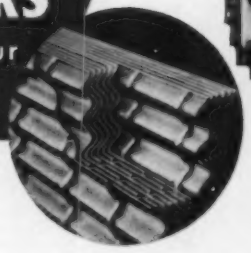


Fig. No. 5800A Conservation Vent unit consisting of "VAREC" Vent Valve in combination with VAREC Flame Arrester

The belief that conservation vents or breather valves alone will prevent travel of flame back into flammable liquid storage tanks is questionable because of the many contributing factors. Careful authoritative analysis reveals that valves by themselves do provide *some protection* but this "*protection*" *is by no means adequate* under all circumstances.

Safety authorities emphatically advise that "vent valves are not regarded as providing the required protection against fire and explosion." A textbook on safety states that "a conservative policy is to provide flame arresters in conjunction with other vent equipment on all cone-roof atmospheric tanks handling oils with a flash point up to 200° F. open cup."

"VAREC" Flame Arresters when used as a unit with "VAREC" Vent Valves give you full fire protection at extremely low cost. Average installations run approximately .1 of 1% of your investment in tank and products. Consult your nearest "VAREC" representative or write for further information.

P-16

THE VAPOR RECOVERY SYSTEMS COMPANY
COMPTON, CALIFORNIA, U. S. A.
Cable Address: VAREC COMPTON USA (All Codes)
New York — Boston — Pittsburgh — Chicago — Detroit — St. Louis — Houston
Tulsa — Casper, Wyo. — Provo, Utah — Los Angeles — San Francisco — Seattle

PROVED and APPROVED "Varec"

Bolt Clearance Sockets

Bonney Forge & Tool Works has added a series of one-fourth inch drive, two inch deep, bolt-clearance sockets. These sockets are precision made, thin-walled and sturdy, eliminating the need for a short extension in hard-to-get-at adjustments. They are especially suited for ignition, carburetor, radio, dash board and interior work on cars and planes. The series is available either singly or in a set of eight progressive sizes, 3/16 up through 7/16.

Circle No. 33 on Postcard

Induction Motors

Construction features of Allis-Chalmers large end shield bearing squirrel-cage induction motors are described in a new bulletin by the company. Built for a wide range of applications the motors are available in ratings and speeds up to 1750 hp at 1800 rpm. Construction features of these motors include welded stator yoke, long-life stator winding, capsule-type housings, split sleeve bearings, air-gap access holes, silver-brazed cage, protecting end shields, large discharge openings, and an inherently drip-proof design.

Circle No. 34 on Postcard

Power Plant Equipment

A Swartwout Company bulletin describing in condensed form the complete line of Swartwout power plant equipment, contains in formation on control valves, pressure master controls, etc., and lists company representatives in the U. S.

Circle No. 35 on Postcard

Packaged Power

Designated as Bulletin GEA-5600, General Electric's newest publication outlines methods of obtaining electric power equipment for quick expansion at low cost and with a minimum of critical materials. The "packaged units" are comprised of standardized components that eliminate the need for individually-engineered assembly of piecemeal components. Each package is a complete, factory-assembled unit designed for a specific job and ready for operation upon delivery. Other G-E bulletins giving information on available equipment for industrial power expansion are listed.

Circle No. 36 on Postcard

Liquid Storage Tank

Hammond Iron Works describes its newly developed Diaflote, liquid storage tank, in Bulletin 51 DF. The unique construction features a Vulcalock membrane which is attached to the inside periphery of the tank and rests on the surface of the stored liquid. The Vulcalock acts as a barrier between the liquid and the air in the tank to prevent the formation of vapors. Information on breathing and filling losses, contamination, aeration, etc., is given in the bulletin.

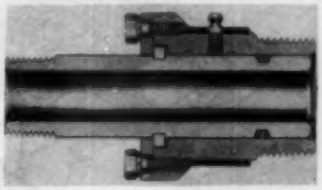
Circle No. 37 on Postcard

Heat Sensitive Paint

Tempil® Corporation has Thermindex temperature-indicating paint for research and development work. These paints are available in 16 basic shades which undergo color changes at predetermined temperatures. Many Thermindex paints exhibit successive color transformation at several temperature levels and indicate when a surface temperature has attained or exceeded a predetermined heat value.

Circle No. 38 on Postcard

Swing Joints



A new line of swing joints which are particularly applicable to gasoline and oil tank car or truck loading and unloading lines is being manufactured by Barco Manufacturing Company, maker of flexible pipe joints. The particular advantage of the new design is the simplicity in providing for 360 degree rotation of the joint with a long bearing surface to support the weight of normal piping. When used in pairs, connected by 90 degree ell, they provide for up-and-down and side-to-side action desirable for loading or unloading lines.

Circle No. 39 on Postcard

Blow-Off Valves

Yarway Bulletin B-425 which replaces an earlier bulletin of that classification, gives up-to-date information on blow-off valves for pressures up to 400 pounds. It is printed by Yarnall-Waring Company.

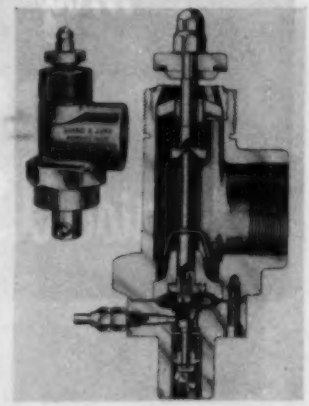
Circle No. 40 on Postcard

Caustic Soda Bulletin

Pennsylvania Salt Manufacturing Company issued a Caustic Soda bulletin providing handy reference for particular problems on purchasing, handling, storage, as well as equipment design and technical data.

Circle No. 41 on Postcard

LP Safety Valve



A new internal safety valve for LP-Gas truck tanks is manufactured by Shand & Jurs Company. Named "Safetiflo," this valve is designed to replace the commonly used excess flow check and shut-off valves and provides increased safety in the delivery of LP-Gas pressure for fully automatic operation. The valve is installed in the tank outlet, with the shut-off valve seat inside the tank shell. A pilot line connects the discharge side of the pump to the pilot side of a diaphragm in the valve body. The catalog describing "Safetiflo" is available.

Circle No. 42 on Postcard

Materials Handling

Efficient handling of raw and finished materials, proper storage, and lower cost by materials handling machines are the subjects covered in Clark Equipment Company's newest booklet, "Basic Facts About Materials Handling."

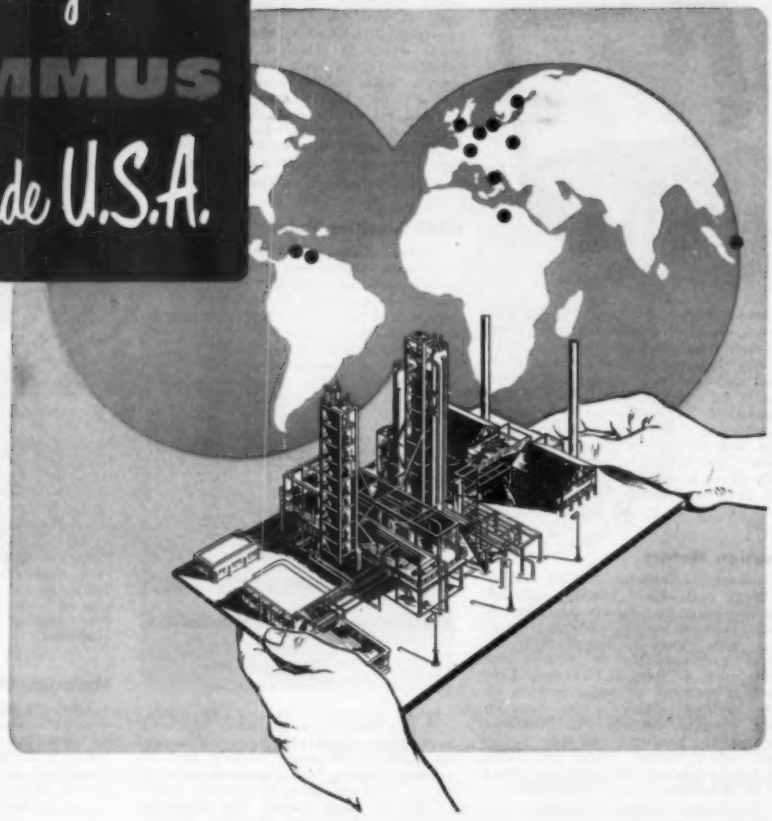
Circle No. 43 on Postcard

Low Pressure Relief Valve

Availability of a new type A-120 relief valve that features positive, accurate control on two psi. air pressure and large volume exhaust at three psi. pressure was announced by the Andrews-Alderfer Processing Company, Inc. Originally developed for use on inflatable rubber boats, the new low-pressure valve has been engineered for end uses involving specifications too exacting for conventional type relief valves. A-120 permits one way flow only. The working parts are mounted in a flexible rubber base, protected by a steel cap and rubber shield.

Circle No. 44 on Postcard

...by LUMMUS ...outside U.S.A.



Dots on the globe indicate countries where scores of post-war refinery and chemical projects carry the seal "... by Lummus".

All classes of Lummus service—process design, engineering, construction—are represented in these overseas projects. In a number of cases, combined projects constitute complete oil refineries.

Processes employed include distillation; propane deasphalting; catalytic and thermal cracking; reforming; Polyforming; coking; lube oil manufacture by solvent refining, solvent dewaxing and clay treating; and petroleum chemicals production.

Each job—whether just starting, partially completed, or on stream—bears the Lummus stamp of over-all competence and international experience.

We invite you to consult Lummus on *your* next project.

THE LUMMUS COMPANY

385 MADISON AVENUE, NEW YORK 17, N. Y.

CHICAGO • HOUSTON • LONDON • CARACAS • PARIS

DESIGNING ENGINEERS AND CONSTRUCTORS FOR THE PETROLEUM AND CHEMICAL INDUSTRIES

Portable Carrier

An inexpensive portable carrier that permits one man to move heavy drums and barrels about with maximum safety and ease has been developed by Allied Dealers Supply. Constructed of one-quarter inch angle iron and welded throughout for safety and durability, the "Handy Van" has characteristics of both a hand truck and a dispensing rack. After lifting the drum or barrel onto the carrier, which has a 1000 pound capacity, transport it to the place of use, tilt the "handy man" onto its back, and it becomes a waist-high storage rack for convenient dispensing. The handles telescope out of the way. It is available with either rubber tired or metal wheels.

Circle No. 45 on Postcard

Anti-rust Primer

Rust removal is an unnecessary "headache" according to Rusticide Products Company which has produced a primer for rusted surfaces. OSPHO, a carefully balanced formula of Orthophosphoric and Dichromate with extenders and wetting agents can be applied directly to the rusted surface without labor consuming removal of rust. Loose rust and scale must be removed with a wire brush, of course. Not a paint, but a primer, OSPHO causes the iron oxide to chemically change to iron phosphate, an inert, hard, dark grey substance. Rust action is stopped and the subsequent paint attaches itself so tightly that moisture and oxygen cannot attack the metal says the manufacturer.

Circle No. 46 on Postcard

Processing Pump

Allis-Chalmers Manufacturing Company has produced a new oil-lubricated bearing, pedestal-mounted pump for handling chemicals, liquors, corrosive materials and solutions, hot liquids, and petroleum. The liquid end of the pump is a complete self-contained unit, available in stainless steel, monel metal, nickel, or other special material to handle liquids which would attack iron or bronze. The pedestal is of cast iron construction with two anti-friction bearings supporting the pump shaft. Pump sizes are available in capacities to 1200 gallons per minute at heads to 250 feed and temperatures to 500° F. Bulletin "Oil Lubricated Pedestal Mounted Pump."

Circle No. 47 on Postcard

Heat Exchangers

Large brazed aluminum heat exchangers for chemical processes manufactured by The Trane Company, air conditioning, heating and ventilating specialists, are said to perform heat transfer tasks in one-fourth the space, with one-third the weight, and at approximately one-half the cost of comparable conventional units. Some of the units pack up to 450 square feet of heat transfer surface into a cubic foot of space. The "waffle like" heat transfer "cores" represent the most important advance in heat transfer engineering in 25 years according to Trane engineers.

Circle No. 48 on Postcard

Corrosion Chart

A new 12 x 9 inch card to hang on the wall gives useful corrosion resistance information for several analyses of stainless steel tubing and pipe. It is offered by The Carpenter Steel Company, Alloy Tube Division. Corrodents ranging in severity from fresh water and blood to sulfuric and hydrochloric acids are listed, with the recommended alloys for use with each. The reverse of the chart contains data on standard tubing sizes as well as dimensions, pressures and tolerances for stainless pipe in schedules 5, 10 and 40.

Circle No. 49 on Postcard

Scraper

The Tractor Sales Corporation, Los Angeles, distributors for Leland T. McGee Angledozers, now markets a new McGee Scraper. Among the unique features of the McGee Scraper is the ability to back-fill, scarify and grade (both rough and finish). The scraper is capable of scraping for school yards, playgrounds, airports, streets, driveways, athletic fields, subdivisions, gardens, lawns, black top spreading, etc.

The McGee Scraper has cradle action and a hydraulic upper-link control.

This exclusive, patented hydraulic control is the first time hydraulic control of scraping angles has ever been applied to a scraper, according to Tractor Sales. The operator, with but a touch of the control valve adjusts the tilt of the scraper. The tilt can be changed for scraping, backfilling or scarifying.

Circle No. 50 on Postcard

Bench Parts-Cleaner

A low cost Bench Type Parts Cleaner, the Brush-Flush, with handy fountain brush action, was developed by Graymills Corporation. It features a hollow handle brush attached to the pump with a tube, to produce a steady flow at the end of the bristles. Parts are cleaned on the large screen platform which "captures" dirt flushed off the parts. Grit, chips, etc., passing through the platform screen are retained by the baffle located at the pump intake. Can be used with any 115 volt electric outlet.

Circle No. 51 on Postcard

Viscosimeter

Description, illustration and reference material on the G. E. Zahn Viscosimeter is available now in a brochure published by Henry A. Gardner Laboratory, Inc. Measurements of the Viscosimeter are expressed in seconds—the time required for a definite volume of liquid to flow through an orifice in the bottom of a metal cup. Such measurements can be made in about 20 to 40 seconds: To use the apparatus you simply check the temperature of the liquid; dip the Zahn cup into the liquid; start stop watch as cup leaves the surface; stop the watch as flow breaks.

Circle No. 52 on Postcard

Pyrometers

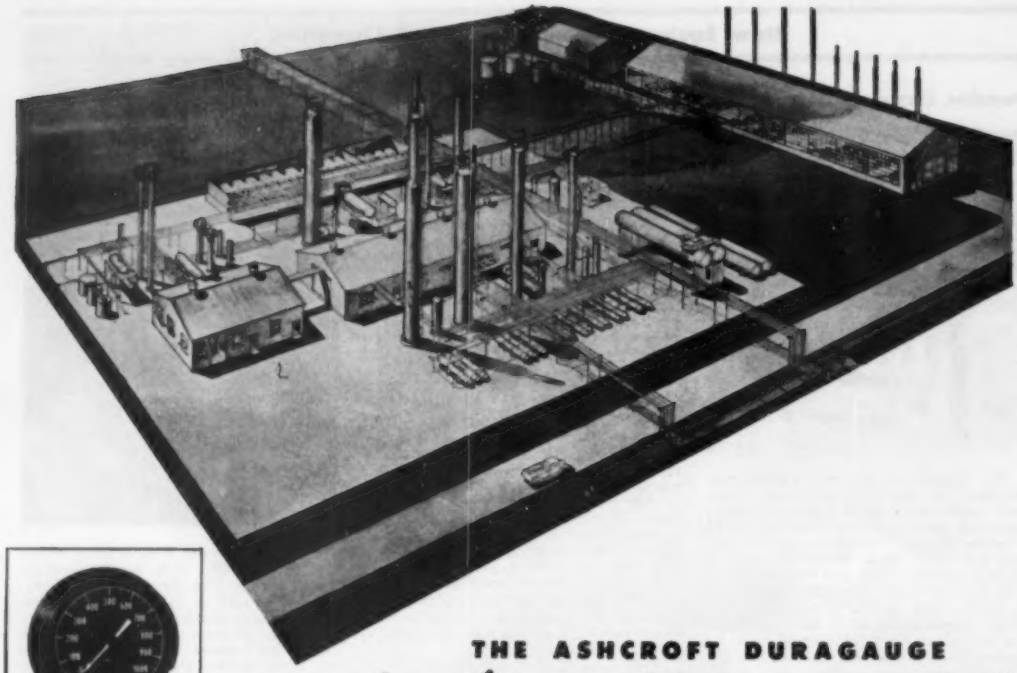
The Bristol Company published a bulletin, Number P1244, on millivoltmeter type indicating pyrometers and pyrometer controllers for temperatures up to 4000° F. Information on automatic controllers for use with gas, electric, and oil fired furnaces is given.

Circle No. 53 on Postcard

Nickel Welding

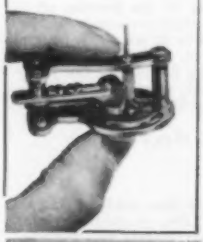
A new booklet, Technical Bulletin T-2, on the fusion welding of nickel and the high nickel alloys has recently been published by The International Nickel Company, Inc. A complete technical treatise, it covers various forms of electric arc welding as well as gas welding.

Circle No. 54 on Postcard



DURAGAUGE SPECIFIED!

Ashcroft Duragauges are installed in The Pure Oil Company's Crude Stabilization and Gasoline-LPG Recovery Plant at Worland, Wyoming. Contractor: C. F. Braun & Co., Alhambra, California.



THE ASHCROFT DURAGAUGE

...tough, sensitive, accurate!

The Ashcroft Duragauge has a performance record second to none. Long life in "killing" services in refineries, chemical plants, and power stations prove it.

Ashcroft engineers made the Duragauge the standard of industry by discarding traditional theories about pressure gauge construction. They developed a movement with *nylon* pinion gear and bearings.

The Nylon Movement* is light, strong and dimensionally stable. Friction and wear are minimized. corrosion resistance is increased

Shock impact absorption is high. Maintenance is reduced. Overall advantages: greatly improved indicating sensitivity and sustained accuracy. The Duragauge, with Nylon Movement, outlasts all others.

The petroleum industry is faced with demands for increased defense and civilian production. The Duragauge can help assure uninterrupted operation. Get all the facts from your Ashcroft Distributor. Let him help you select the right Duragauge for *your* plant.

* Patented

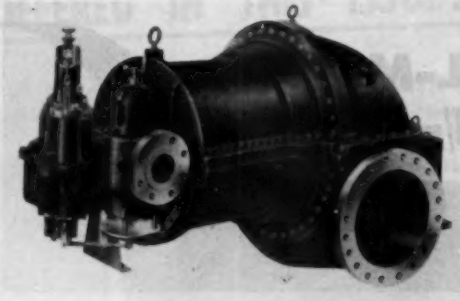
1858 ASHCROFT U.S.A.

ASHCROFT GAUGES

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

MAKERS OF 'ASHCROFT' GAUGES, 'HANCOCK' VALVES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN' INDUSTRIAL INSTRUMENTS. BUILDERS OF "SHAW-BOX" CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

Mechanical-Drive Turbine



A line of multi-stage, mechanical-drive turbines in ratings from 200 to 5000 hp. has been designed by General Electric Company's Turbine Department. The new units have been designed to cover a wide range of industrial applications. Type DR turbine, pictured herewith, is built for applications requiring wider speed range, greater accuracy of control and greater capacity than can be obtained from other types. The oil-relayed governor on the turbine makes a speed range up to six to one possible, with only four percent regulation and one-half percent steady state speed variation.

Circle No. 57 on Postcard

Ring Packing

Automatic ring packing, known by the trade-name "Uneepac," was developed recently by Johns-Manville. A molded packing, each ring is a complete, self-contained packing unit. Recommended particularly in the design of new equipment, maximum sealing efficiency in minimum packing depth is the feature utilized to reduce stuffing box sizes. Each ring centers itself perfectly on the preceding ring eliminating need of follower or header rings. In service, exposure to fluid pressure provides instant, positive sealing.

Circle No. 55 on Postcard

Internal Purifier

First of a new line of low-cost purifiers to be manufactured by The V. D. Anderson Company, is on the market. This purifier, called the Anderson Hi-eF, is of the internal type and has a wide range of applications inside steam drums, flash tanks, evaporators, packed towers, bubble-cap towers, etc. Anderson guarantees it will deliver vapor with 1.0 ppm or less, of total solids. Other advantages claimed for the unit is elimination of baffling which accompanies ordinary separators, no moving parts, self cleaning action, and low pressure drop. Condensed Bulletin 100 describes the new purifier.

Circle No. 56 on Postcard

Tank Venting Units

Bulletin Number CP-2001 describes "Varec" Tank Venting equipment manufactured by Vapor Recovery Systems Company. It also contains data on gas control and safety devices for the safe handling and conservation of combustible or toxic liquids, etc.

Circle No. 58 on Postcard

Controlled Volume Pumps

Milton Roy Controlled Volume Pumps is the name of a recent publication by Milton Roy Company and will be of interest to industrial plants whose operations call for pumping a controlled volume of liquid in amounts as much as 50 gallons per minute or as little as three milliliters per hour.

Circle No. 59 on Postcard

Apparatus

Bulletin 515, Apparatus Notes, issued by Andrew Technical Service, 3805 North Clark Street, Chicago 13, described laboratory equipment. Text includes portable autoclaves, midget refrigerator, vacuum control manostats, motor-driven blender, rotameter flowmeter, flash evaporator for heat sensitive solutions, stainless steel filters, stopwatches, stainless steel needle valves, non-corrosive pumps, and a selection of laboratory items.

Circle No. 60 on Postcard

Industrial Plastic

Tuffstuff has been added to the line of industrial plastics carried by Clopay Corporation. Tuffstuff is a rigid, corrosion resistant plastic piping that is expected to find wide use in the chemical, petroleum, etc. fields, replacing critical metals. In a chemical plant where stainless steel piping had given out in six to nine months, piping made of the new material has been in use for more than two and a half years and is still holding up.

Circle No. 61 on Postcard

Volume Gauge

Distributed by the Emil Greiner Company, the new McLeod Gauge is said to be suitable for the ASTM proposed test for reduced pressure distillation of petroleum products. To assure intrinsic accuracy the gauge has scales graduated in both "square" and "linear" systems. Readings are made directly in millimeter values, and individual precise calibrations of ratios of volumes can also be made directly. Among features of the instrument are a trap to prevent overflow of mercury, extra heavy wall mercury reservoir, a specially designed air filter that prevents contamination of the system, plus a constriction of the main tube that prevents sudden breakage of the flash by a sudden return of the mercury.

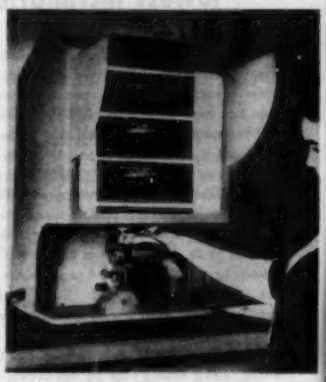
Circle No. 62 on Postcard

Mechanics Tools

A pocket-size tool catalog is issued by Duro Metal Products Company. It describes and illustrates the complete line of Duro-Chrome hand tools and includes information for mechanics.

Circle No. 63 on Postcard

Microfilm Reader



Remington Rand Inc. has added three types of microfilm readers to its line of microfilm equipment. Designed and built by Griscombe Products, Inc., the readers include a portable for field and home use, a Library model for viewing extra-large images, and a third known as the Film-a-Record Model 9 for standard office use. Full screen photoprints can be made in a few minutes with any of the three types. Each reader features high-quality lenses specially coated to reduce reflection and improve contrast. The image shows up sharp and clear in normal light. The readers handle either 16 mm or 35 mm film.

Circle No. 64 on Postcard

Simplest Flow Measurement

with the ALL-METAL Foxboro d/p Cell!

. . . gives fastest response, longest sustained accuracy, lowest installation cost

Simpler in design, simpler and much less expensive to install, far easier to maintain . . . the all-metal Foxboro mercury-less d/p *Cell* offers greater speed of response, permitting closer flow *control*, than has ever been possible before. Its negligible displacement and corrosion-proof construction of Type 316 Stainless Steel eliminate usual maintenance problems, even in service on highly corrosive or viscous fluids previously considered unmeasurable.

The Foxboro d/p Cell measures differential pressure by the force-balance principle and transmits pneumatically to indicating, recording, or controlling receivers. Small, compact, weighs as little as 19 lb. Ranges: from 25" to 800" H_2O. Working pressure ratings up to 4000 psi. Steel or stainless steel construction. Inherent over-range protection. Easy in-the-field calibration and range changes. Optionally available with pre-assembled manifold piping shown in photo above.

Thousands of d/p Cells now in use throughout industry, with many repeat orders now on our books, indicate the wide acceptance and successful performance of this revolutionary development for the measurement of liquid, steam, gas, or air flow. Write for detailed Bulletin 420. **The Foxboro Company, 7410 Neponset Avenue, Foxboro, Massachusetts, U. S. A.**

- No seal pots
- No mercury
- No leveling
- Installed at the orifice

RECORDING · CONTROLLING · INDICATING

INSTRUMENTS

FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND

Catalogs AND EQUIPMENT *Literature* OFFERED IN THIS ISSUE'S ADVERTISEMENTS

Copies may be obtained easily and without cost by using Reader Service Postcard. Just circle on the card the identifying key number of each item in which you are interested. Postcards are opposite page 192.

TUBE CLEANER AND EXPANDER—Data. Aire-tool Manufacturing Co. See advertisement page 210.
Circle A3 on postcard.

ABRASIVE ROLLED STEEL FLOOR PLATE—Booklet B-18. Alan Wood Steel Co. See advertisement page 208.
Circle A6 on postcard.

ALUMINUM HEAT EXCHANGER TUBES—24-page booklet. Aluminum Company of America. See advertisement page 211.
Circle A6 on postcard.

ACTIVATED ALUMINA—Information. Aluminum Company of America. See advertisement page 57.
Circle A5 on postcard.

TUBES AND PLATES FOR CONDENSERS AND HEAT EXCHANGERS—Booklet B-2. The American Brass Co. See advertisement page 83.
Circle A7 on postcard.

CONTROL VALVES—Catalog. The Annin Company. See advertisement page 47.
Circle B2 on postcard.

STEAM TRAP VALVE—Catalog. Armstrong Machine Works. See advertisement page 5.
Circle B3 on postcard.

FIREBRICK—Bulletin B-29. The Babcock & Wilcox Co. See advertisement page 92.
Circle B5 on postcard.

INSULATION—Information. Baldwin-Hill Co. See advertisement page 231.
Circle B7 on postcard.

PIPE AND BOLT MACHINE—Catalog. Beaver Pipe Tools, Inc. See advertisement page 240.
Circle B8 on postcard.

TEMPERATURE CRAYONS—Data. Big Three Welding Equipment Co. See advertisement page 240.
Circle C1 on postcard.

REGULATOR VALVES—Catalog 109. Black, Sivalls & Bryson, Inc. See advertisement page 185.
Circle C2 on postcard.

CONDENSER AND HEAT EXCHANGER TUBING—Bulletin 1950. Bridgeport Brass Co. See advertisement page 91.
Circle C6 on postcard.

CONTROLLER—Bulletin A120. The Bristol Co. See advertisement page 18.
Circle C7 on postcard.

HEAT EXCHANGERS—Bulletin 481. The Brown Fintube Co. See advertisement page 204.
Circle C8 on postcard.

CENTRIFUGAL PUMPS—Catalog. Byron Jackson Co. See advertisement page 9.
Circle C9 on postcard.

TOWER ESCAPE DEVICE—Folder. Charlie's Machine Works. See advertisement page 236.
Circle D3 on postcard.

HEAT EXCHANGER TUBES—Booklet. Chase Brass & Copper Co. See advertisement page 79.
Circle D4 on postcard.

COMPRESSORS—Literature. Clark Bros. Co. See advertisement pages 76-77.
Circle D8 on postcard.

STEAM TRAPS—Information. The Clark Manufacturing Co. See advertisement page 170.
Circle D9 on postcard.

STEAM JET EVACTOR—Data. Croll-Reynolds Co. See advertisement page 221.
Circle E6 on postcard.

PETROLEUM CHEMICALS—Literature. E. I. du Pont de Nemours & Co. See advertisement Insert 160-161.
Circle F4 on postcard.

MECHANICAL SEAL—Bulletin No. DSPR. Durametallic Corp. See advertisement page 190.
Circle F5 on postcard.

PROTECTIVE COATINGS—Booklet. Earl Paint Corp. See advertisement page 85.
Circle F7 on postcard.

STAINLESS STEEL PIPING—Information. Electric Steel Foundry. See advertisement page 171.
Circle F8 on postcard.

AIR COOLED MOTORS—Bulletin. Elliott Co. See advertisement page 163.
Circle G1 on postcard.

LIQUID LEVEL CONTROL—Bulletin F-3. Fisher Governor Co. See advertisement page 54.
Circle G5 on postcard.

FLOW MEASUREMENT INSTRUMENT—Bulletin 420. The Foxboro Co. See advertisement page 202.
Circle G9 on postcard.

PACKINGS—Folder. The Garlock Packing Co. See advertisement page 31.
Circle H1 on postcard.

MULTI-STAGE TURBINES—Bulletin GEA-5580. General Electric Co. See advertisement page 12-13.
Circle H2 on postcard.

STEEL STRAPPING CALCULATOR—Data. A. J. Gerrard & Co. See advertisement page 235.
Circle H4 on postcard.

PLANT CONSTRUCTION SERVICE—Bulletin. The Girdler Corp. See advertisement page 11.
Circle H6 on postcard.

REFRACTORY LINING—Information. A. P. Green Fire Brick Co. See advertisement page 63.
Circle H7 on postcard.

MIXERS—Catalog. International Engineering, Inc. See advertisement page 174.
Circle J3 on postcard.

DUCTILE IRON—Catalog. The International Nickel Co. See advertisement page 7.
Circle J4 on postcard.

WIRE MESH—Catalog. The C. O. Jelliff Mfg. Corp. See advertisement page 234.
Circle J6 on postcard.

BLOCK INSULATION—Brochure IN-134A. Johns-Manville. See advertisement page 104.
Circle J8 on postcard.

HEAT EXCHANGER GASKETS—Catalog. Johns-Manville. See advertisement page 16.
Circle J7 on postcard.

ASBESTOS SIDING ROOFING—Data. Keasbey & Mattison Co. See advertisement page 32.
Circle J9 on postcard.

FRACTIONATING TRAYS—Brochure 629. Koch Engineering Co. See advertisement page 169.
Circle K3 on postcard.

WATER WELL SYSTEMS—Catalog. Layne & Bowler, Inc. See advertisement page 223.
Circle K4 on postcard.

TEMPERATURE RECORDER—Folder NDA6-33A(L). Leeds & Northrup Co. See advertisement page 8.
Circle K5 on postcard.

COALESCER—Bulletin. Warner Lewis Co. See advertisement page 236.
Circle K6 on postcard.

COOLING TOWER FAN CYLINDERS—Catalog LP-30a. The Marley Co. See advertisement page 103.
Circle K9 on postcard.

OIL HANDLING EQUIPMENT—Catalog. A. Y. McDonald Mfg. Co. See advertisement IV Cover.
Circle L3 on postcard.

MIST ELIMINATORS—Brochure. Metal Textile Corp. See advertisement page 225.
Circle L6 on postcard.

PROCESS CONTROL RECORDER—Catalog 769. Minneapolis-Honeywell Regulator Co. See advertisement pages 36-37.
Circle L7 on postcard.

MIXING-BLENDING EQUIPMENT—Literature. Mixing Equipment Co. See advertisement page 194.
Circle L8 on postcard.

LUBE OIL ADDITIVES—Catalog. Monsanto Chemical Co. See advertisement page 51.
Circle L9 on postcard.

HEAT INSULATION—Data Manual. Mundet Cork Corp. See advertisement page 212.
Circle M1 on postcard.

STEAM TURBINES—Bulletin. Murray Iron Works Co. See advertisement page 189.
Circle M2 on postcard.

STEAM TRAPS—Catalog 751. W. H. Nicholson & Co. See advertisement page 226.
Circle M7 on postcard.

MAINTENANCE CLEANING PROCEDURES—Free Booklet. Oakite Products, Inc. See advertisement page 223.
Circle M8 on postcard.

SIDE ENTERING AGITATORS—Data. The Patterson Foundry & Machine Co. See advertisement page 227.
Circle N5 on postcard.

AUTOMATIC VALVE CONTROLS—Catalog L-50. Philadelphia Gear Works, Inc. See advertisement page 175.
Circle N8 on postcard.

GAS DRYING SYSTEM—Information. Pittsburgh Lectrodryer Corp. See advertisement page 207.
Circle N9 on postcard.

BUBBLE CAPS—Bulletin 21. The Pressed Steel Co. See advertisement page 15.
Circle P2 on postcard.

HEAT EXCHANGER—Information. J. F. Pritchard & Co. See advertisement page 217.
Circle P3 on postcard.

GAS DEHYDRATION—Bulletin No. 16.0.000. J. F. Pritchard & Co. See advertisement page 230.
Circle P4 on postcard.

FIRE PROTECTION—Catalog. Pyrene Manufacturing Co. See advertisement page 170.
Circle P6 on postcard.

HEAT EXCHANGER TUBES—Data. Republic Steel Corp. See advertisement page 172.
Circle P9 on postcard.

CONDENSER TUBES BOOKLET. Revere Copper and Brass, Inc. See advertisement page 239.
Circle Q1 on postcard.

DIAL THERMOMETERS—Catalog IT-650. Rochester Manufacturing Co. See advertisement page 229.
Circle Q3 on postcard.

BALL VALVES—Bulletin V4. Rockwood Sprinkler Co. See advertisement page 61.
Circle Q5 on postcard.

GAS DISPLACEMENT METERS—Bulletin 40-B-14. Roots-Connersville Blower Corp. See advertisement page 175.
Circle Q6 on postcard.

CONDENSER TUBES—Booklet. Scovill Manufacturing Co. See advertisement page 17.
Circle Q7 on postcard.

ROTARY SHAFT SEALS—Data. Sealol Corp. See advertisement page 229.
Circle Q8 on postcard.

SCREW PUMPS—Bulletin. Sier-Bath Gear and Pump Co. See advertisement page 224.
Circle R3 on postcard.

PUMP VALVES—Catalog. Sims Pump Valve Co. See advertisement page 234.
Circle R4 on postcard.

SAFETY GRATINGS—Information. A. O. Smith Corp. See advertisement page 232.
Circle R5 on postcard.

DIRECT FIRED HEATERS—Bulletin B-45. Struthers-Wells Corp. See advertisement page 43.
Circle R6 on postcard.

WELDING FITTINGS—Data. Taylor Forge & Pipe Works. See advertisement page 23.
Circle R9 on postcard.

PIPE INSULATIONS—Catalog 76-109. Union Asbestos & Rubber Co. See advertisement page 52.
Circle S3 on postcard.

FLAME ARRESTERS—Information. The Vapor Recovery Systems Co. See advertisement page 196.
Circle S4 on postcard.

FLOATING TUBE SHEET ASSEMBLY—Bulletin HE-6, Henry Vogt Machine Co. See advertisement page 46.
Circle S5 on postcard.

CHLORINATOR—Information. Wallace & Tiernan Products, Inc. See advertisement page 183.
Circle S7 on postcard.

CAST STEEL VALVES—Circular 134. Walworth Co. See advertisement page 53.
Circle S8 on postcard.

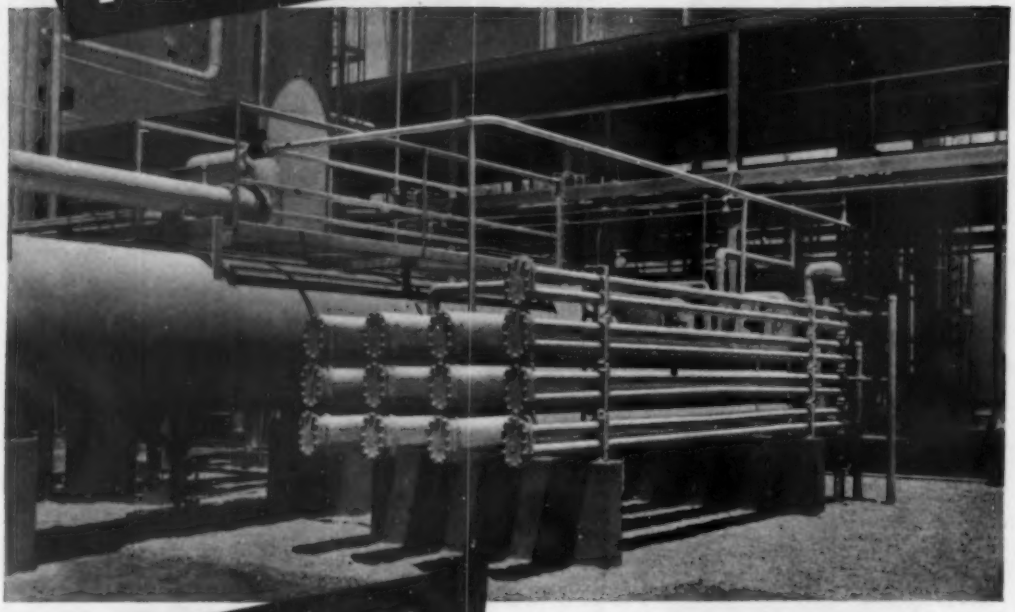
STEAM TURBINES—Data. Whiton Machine Co. See advertisement page 235.
Circle T2 on postcard.

STEAM TURBINES—Bulletins. Worthington Pump & Machinery Corp. See advertisement page 41.
Circle T4 on postcard.

STEAM TRAPS—Information. Yarnall-Waring Co. See advertisement II Cover.
Circle T6 on postcard.

HEAT TRANSFER EQUIPMENT—Information. Young Radiator Co. See advertisement page 3.
Circle T7 on postcard.

Assure Flexibility in your plant



with BROWN FINTUBE *sectional hairpin heat exchangers*

● You'll get almost unlimited flexibility to meet changes in duties, plant re-arrangements, etc., with Brown Fintube Sectional Heat Exchangers. By simply adding a few sections to your existing exchangers, or removing a few sections, or changing the series-parallel manifolding, change-overs can be made easily and quickly. You can be operating *efficiently* on almost any new or different duty, on short notice, with a minimum of expense for new equipment, and without obsoleting any of your former facilities.

For utmost efficiency and economy use Brown Fintube Sectional Heat Exchangers throughout your plant. *Write for Bulletin No. 481.*

THE BROWN FINTUBE CO.

Elyria, Ohio

Sectional Hairpin Heat Exchangers
Tank Suction and Line Heaters
Fintube Heaters for Bulk Storage Tanks
Indirect Process Air Heaters
Fintube Heaters for Processing Tanks
Integrally Welded Fintubes for Any Heating, Cooling or Heat Transfer Service

NEW YORK • BOSTON • PHILADELPHIA • WILMINGTON • PITTSBURGH • BUFFALO • CLEVELAND • CINCINNATI • DETROIT • CHICAGO
ST. PAUL • ST. LOUIS • MEMPHIS • BIRMINGHAM • NEW ORLEANS • TULSA • HOUSTON • LOS ANGELES • SAN FRANCISCO

Digest of Recent U. S. PATENTS Pertaining to PETROLEUM REFINING

Compiled by DR. HEINZ HEINEMANN

(From the Official Gazette, July 17, 24, 31 and August 7, 1951)

REFINING

U.S.P. 2,560,602. Fuel Composition. W. A. Schulze and J. E. Mahan to Phillips Petroleum Company.

A fuel composition essentially consists of branched chain paraffins with 5-9 C atoms, and 1-20 percent by volume of at least one picoline. The composition has gasoline characteristics, rich mixture performance and improved lead response.

U.S.P. 2,560,632. Stabilizing Cracked Distillate. P. H. Carnell to Leonard Refineries, Inc.

Catalytically cracked furnace distillate is stabilized against color and sludge formation by dissolving formaldehyde therein.

U.S.P. 2,560,633. Method of Stabilizing Catalytically Cracked Furnace Distillates and Compositions Therefor. R. F. Stedman to Leonard Refineries, Inc.

The product according to this patent differs from that of U.S.P. 2,560,632 only in that an aliphatic monoamine with 2-20 C atoms is also dissolved in the distillate.

U.S.P. 2,560,645. Method of Separating High Condensation Point Materials from Hydrocarbons. G. E. Hays to Phillips Petroleum Company.

Details are claimed of a method of separating high condensation point materials from a stream of predominantly hydrocarbon vapors, e.g., for purifying hydrocarbon products of a Fischer-Tropsch synthesis.

U.S.P. 2,560,898. Fuel Composition. W. A. Schulze and J. E. Mahan to Phillips Petroleum Company.

The composition according to this patent differs from that of U.S.P. 2,560,602 essentially in that the additive consists of 1-20 percent by volume of at least one pyridine substituted by at least two methyl radicals.

U.S.P. 2,560,904. Diesel Fuel. R. Sugimoto to Ethyl Corporation.

A diesel fuel contains a small amount of a gem-dinitrocycloalkane with 5-10 C atoms. The additive decreases the ignition delay period of the fuel.

U.S.P. 2,561,096. Solvent Refining of Wax-Containing Mixtures. E. W. Clarke to The Atlantic Refining Company.

A wax-containing mixture is separated into fractions of higher and lower m.p. by means of nitrobenzene in a process details of which are claimed.

U.S.P. 2,561,396. Segregation of Solid Particles. G. L. Matheson to Standard Oil Development Company.

Details are claimed of a process for the segregation of a mixture of finely divided solids of different particle size by fluidization, e.g., for the separation of catalyst particles of different size.

U.S.P. 2,561,624. Separation of Cyclohexane and Benzene by Azeotropic Distillation. J. M. Harrison to Gulf Research & Development Company.

A mixture of cyclohexane and benzene is separated in a continuous cyclical process employing n-propanol and water for the formation of an azeotrope only of all the cyclohexanol. On distillation a ternary azeotrope thereof with n-propanol and water is obtained as the distillate which is further treated to separate the cyclohexane and to re-gain the mixture of n-propanol and water to be recycled.

U.S.P. 2,561,720. Method and Apparatus for Removing Condensables from Gases. C. E. Alleman and D. J. Quigg to Phillips Petroleum Company.

Details are claimed of separating condensable vapors from gases, e.g., for removing heavier hydrocarbons, water, CO_2 and H_2S from natural gas, or for the recovery of ethylene from cracked gasolines, or for the separation of ethane from ethylene. Cooled solid heat exchange material is gravitating in a purification zone while the gas feed is passed countercurrently thereto through this zone.

U.S.P. 2,561,822. Concentration of Olefins. M. Savoy to The Pure Oil Company.

An olefin containing hydrocarbon gas mixture is contacted with an olefin absorbent solution of a cuprous salt in an acidified anhydrous solvent consisting of an alkylolamine and a low-boiling monohydric alcohol, to separate the olefins present in the hydrocarbon mixture. The salt shall be employed in amount in excess of that soluble in the unacidified solvent.

U.S.P. 2,562,068. Separation of Xylene Isomers by Solvent Extraction. M. Souders, Jr., to Shell Development Company.

A mixture essentially containing two isomeric aromatic hydrocarbons, particularly m- and p-xylene is extracted simultaneously with two solvents which under the prevailing conditions are at least partly immiscible with each other and chemically inert. One of these solvents may be SO_2 and the other a low-freezing organic solvent of special properties. The SO_2 extract phase formed is enriched p-xylene, while the organic solvent-extract phase is enriched m-xylene.

U.S.P. 2,562,845. Anticorrosion Composition. T. E. Reamer to Shell Development Company.

A hydrocarbon oil contains a minor amount of an unsubstituted alkylated fused-polycyclic sulfonate. This sulfonate consists of a tetralin nucleus, an alkyl radical of 18-30 C atoms attached to said nucleus, and 1-3 metallic sulfonate groups. The additive has a corrosion inhibiting effect.

U.S.P. 2,562,878. Processes for Breaking Emulsions. C. M. Blair, Jr., to Petrolite Corporation, Ltd.

Petroleum emulsions of the water-in-oil type are broken by a demulsifier which includes an organic polyester of a dicarboxylic acid and a polyhydric alkylene ether glycol the alkylene group of which contains less than six C atoms.

U.S.P. 2,562,885. Thallous Compounds as Rich Mixture Fuel Additives. Maurice R. Barusch and George H. Denison, Jr., to California Research Corporation.

The rich mixture rating of an aviation fuel consisting essentially of a 100-400° F. gasoline is improved by addition of a small amount of a monoelectrovalent thallium salt of an organic acid, without increasing the lean-mixture rating. Between 0.00085 and 0.013 percent of thallium are used in compounds such as thallium naphthenate.

U.S.P. 2,563,101. Fuel Charge for Internal Combustion Engines. A. T. Colwell and M. S. Roush to Thompson Products, Inc.

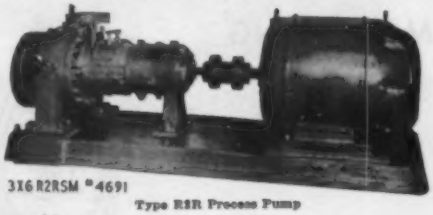
Deleterious deposits in combustion chambers from gum, carbon, tetraethyl lead, etc. are inhibited by the addition to the hydrocarbon fuel of a minor amount (0.1-10 percent) of a reaction product of alcohols and alkylene oxides.

U.S.P. 2,563,344. Azeotropic Distillation of Hydrocarbons with Aqueous Azeotrope Formers. C. B. Leffert and C. H. O. Berg to Union Oil Company of California.

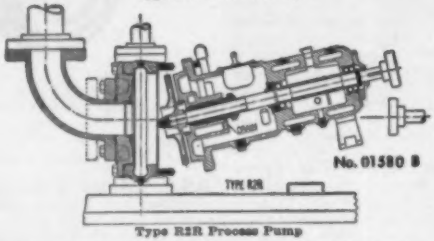
A mixture of benzene and/or toluene with non-aromatic hydrocarbons of similar volatility is azeotropically distilled in a fractionating zone in the presence of a water-soluble alcohol or ketone

DEAN BROTHERS PUMPS INC.

Type R2R Centrifugal Process Pumps



Type R2R Process Pump



Type R2R Process Pump

DISASSEMBLY: The Type R2R process pumps can be disassembled without disconnecting the suction and discharge piping. By first removing the spacer from the spacer type coupling, and unbolting the casing from the cradle the entire cradle and complete rotating element can be removed without disturbing the suction and discharge piping.

OPERATING RANGE: Type R2R. Heavy duty, process pumps are available in eighteen different sizes, enabling our engineers to furnish units specially designed and constructed for the particular work to be performed. Capacities: 50 to 2000 Gallons per minute. Heads: Up to 400'. Speeds: 900 RPM to 4000 RPM.

BUILDERS OF OUTSTANDING PUMPS SINCE 1869

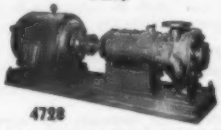
CENTRIFUGAL and RECIPROCATING PUMPS

Close Coupled Centrifugal Pump

Horizontal, Single Style, Double Acting, Piston Type, Close Clearance Pump. Designed to handle volatile liquids

Pedestal Mounted Centrifugal Pump

Horizontal, Duplex, Double Acting, Side Pot, Piston Type, Oil Bath Power Pump



Double Pedestal Bearing Centrifugal Pump

Durable Duplex Packed Piston Pattern Steam Pump, Side Pot Type

ESTABLISHED 1869

DEAN BROTHERS PUMPS INC.

INDIANAPOLIS IND.

323 W TENTH ST.

Branch Offices: NEW YORK, N. Y., HOUSTON, TEXAS

Representatives in Principal Cities

Patents

boiling below the b.p. of water. The azeotropic distillate contains the non-aromatic hydrocarbons, while the aromatics are separated as the distillation residue. The azeotrope former is extracted from the distillate by the introduction of water at the top of the fractionating zone.

U.S.P. 2,563,359. Refining Fuel Oil. Earle W. Reiley, Jr., and Lewis J. Duke to Shell Development Company.

The screen-clogging characteristics, odor, storage stability and color stability of gas or fuel oils are improved by proper combination of a controlled sulfuric acid treat, separation of oil from acid phase, followed by a first clay treatment of separated oil phase, coordinated with the acid treat. One or more subsequent clay treatments of the separated oil phase at selected temperature and with simultaneous air blowing follows.

U.S.P. 2,563,598. Removal of Peroxides from Hydrocarbons and Oxygenated Solvents. M. C. Fugua and B. S. Garrett to Standard Oil Development Company.

Oxygenated solvents containing diolefinic hydrocarbons are often contaminated with organic peroxides causing diolefin polymerization. The peroxides can be removed and polymerization inhibited by contacting the solution at, at least 30° C. in the presence of traces of water with a mass of finely divided iron having unoxidized surfaces.

U.S.P. 2,563,605. Distillation of Acid-Treated Oils. Minor C. K. Jones and Edward C. Eulhardt to Standard Oil Development Company.

Acid treated mineral oils containing acid esters are distilled in the presence of 90-95 percent of the quantity of caustic which would theoretically neutralize the esters and 5-10 percent of the quantity of alkali phenates which would fully neutralize the esters.

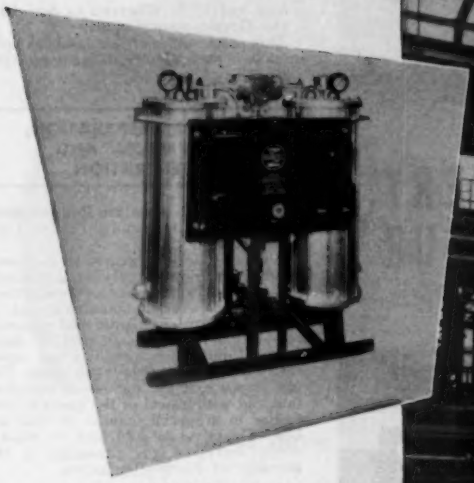
U.S.P. 2,563,628. Treatment of Olefin-Containing Aromatic Hydrocarbons with Acid and Alkali. P. S. Viles to Standard Oil Development Company.

A hydrocarbon fraction comprising aromatics and olefins is contacted with acid to remove olefins. The acid contacted aromatic fraction is heated to a temperature of 300-350° F. and then neutralized with a concentrated caustic alkali aqueous solution and held in contact therewith for at least ten minutes. An aromatic hydrocarbon phase, a caustic alkali aromatic sulfonate phase, and a caustic alkali phase are separated from one another.

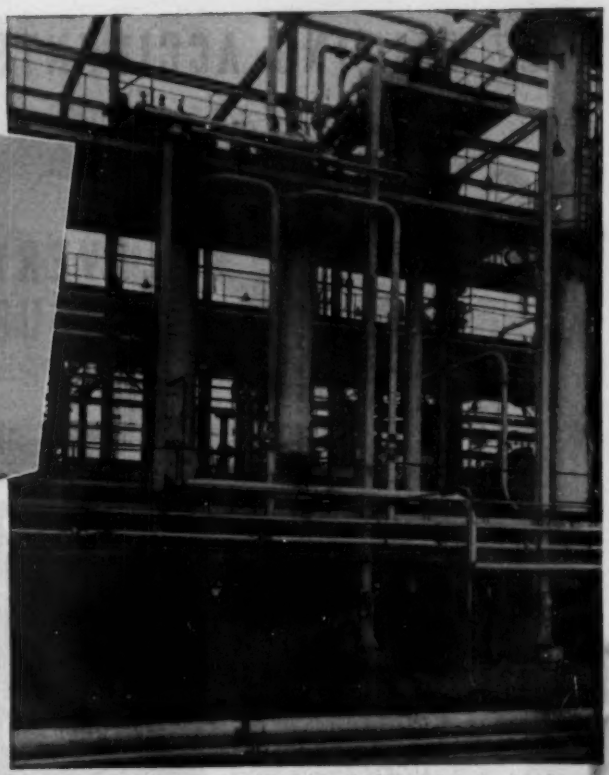
U.S.P. 2,563,685. Regeneration of Olefins from Acid Solutions. M. D. Mann, Jr., and H. O. Mottern to Standard Oil Development Company.

A monoolefin containing 2-6 C atoms per mol is regenerated from an acid extract thereof by passing the liquid extract through an electrically heated cylindrical decomposition zone of predetermined dimensions at a velocity of 0.4-2.0 ft./sec. at a temperature of 130-295° C. The extract is decomposed to monoolefin vapor, water vapor and liquid acid which are rapidly separated in a disengaging zone.

U.S.P. 2,563,686. Regeneration of Olefins from Acid Solution. F. M. Archi-



British-built Type BAC Lectrodryer.



This pair of columns is a Lectrodryer DRYing hydrocarbon liquids and gases in a British oil refinery. Built by BIRLEC, Ltd., of Birmingham, England, Stockholm, Sweden, and Sydney, Australia.

WETth
(unwanted moisture)
is an international problem

DRYing with Lectrodryers is worldwide, because WETth plays no favorites. Moisture leads chemical reactions astray, permeates materials being processed and in storage, slowing down production and impairing quality.

Companies that hope to compete in international trade must have the time-and money-saving advantages gained by employing Lectrodryers to remove unwanted moisture.

Air, gases and organic liquids are handled by Lectrodryers—DRYing to dewpoints below −110°F., a few cubic feet per hour or thousands, manually controlled or fully automatic, at atmospheric pressure or 5,000 psi.

Lectrodryer engineers will help you select the equipment you need to do any DRYing job. Write Pittsburgh Lectrodryer Corporation, 307 32nd Street, Pittsburgh 30, Pennsylvania.

In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.
In Australia: Birlec, Limited, 51 Parramatta Road, Glebe, Sydney.
In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.
In Belgium: S. A. Belge Stein et Roubaix, 320 Rue de Hesdin, Bressoux-Liege.

LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

LECTRODRYER

REGISTERED TRADEMARK U.S. PAT. OFF.

37 FALLING ACCIDENTS EVERY HOUR*

WILL ONE OF YOUR MEN BE NEXT?

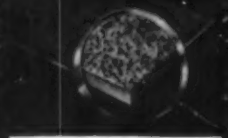
Every hour, falling accidents kill or disable 37 workmen!*

Are you sure your men are safe from unsafe footing?

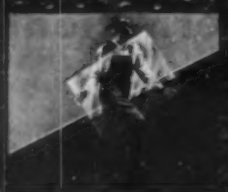
You can give your workmen maximum protection against costly slipping and falling accidents with A. W. ALGRIP Abrasive Rolled Steel Floor Plate. ALGRIP is made by rolling tough abrasive grain as an integral part of the upper portion of steel floor plate. Wet or dry ALGRIP gives non-slip protection even on steep inclines. Wear only exposes new abrasive particles so maintenance is not required.

Engineers, architects, purchasing agents, and safety engineers are specifying A. W. ALGRIP for thousands of industrial and commercial applications. Follow their lead. Get more information now. Write for booklet B-18.

THERE'S NEVER A SLIP ON A.W. ALGRIP!



Magnification shows even distribution of abrasive grain in A.W. ALGRIP.



Even on steep inclines A.W. ALGRIP IS NON-SLIP!

A.W. ALGRIP ABRASIVE ROLLED STEEL FLOOR PLATE

ALAN WOOD STEEL COMPANY

CONSHOHOCKEN, PA.

125 Years of Iron and Steel Making Experience

Gentlemen:
Please send me your 8-page information-packed booklet B-18.

NAME _____ TITLE _____

COMPANY _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

Other Products: PERMACLAD Stainless Clad Steel • A.W. SUPER-DIAMOND Floor Plate Plates • Sheets • Strip • I-Alloy and Special Grades

*17% of the 222 occupational injuries which occur every hour are due to falls. Source: National Safety Council's 1949 edition of Accident Facts.

Patents

bald and V. F. Mistretta to Standard Oil Development Company.

This patent differs from 2,563,685 only in that a non-cylindrical decomposition zone is employed.

CATALYST PREPARATION, ACTIVATION, AND REGENERATION

U.S.P. 2,561,331. Catalyst Regeneration. J. W. Barker to Houdry Process Corporation.

A catalyst to be regenerated is passed in hot state downwardly as a compact bed through a plurality of combustion zones while oxygen-containing gas is separately introduced into and countercurrently flowed through each of these zones. Combustion products are separately withdrawn from each zone. The gas pressure at the regions of introduction and withdrawal of the gases is controlled in a special manner so that the bed of catalyst is subjected to successively increased gas pressures in the plurality of combustion zones.

U.S.P. 2,561,408. Catalyst Regeneration. C. C. Peavy to Houdry Process Corporation.

Details are claimed of a process and apparatus for catalyst regeneration with the use of relatively cold oxygen-containing gas admitted to an intermediate section of the kiln.

U.S.P. 2,561,409. Processes Employing Fluent Solids. D. B. Ardern to Houdry Process Corporation.

Coked catalyst from a hydrocarbon conversion is passed downwardly through a series of vertically superimposed regeneration zones in compact non-turbulent bed form while oxygen-containing gas is introduced separately to the uppermost and the lowermost zone. Hydrogen is preferentially burnt in the coke deposit of the catalyst to produce and discharge wet flue gas in and from the uppermost zone, while relatively dry flue gas is discharged from the lowermost zone. Regenerated catalyst is elevated by wet gas from the uppermost zone for re-use.

U.S.P. 2,561,711. Process Employing Fluent Solids. D. B. Ardern to Houdry Process Corporation.

The process according to this patent is very closely related to that of U.S.P. 2,561,409, the main difference being that in the present case the relatively dry flue gas is employed as the lifting gas.

U.S.P. 2,562,608. Purification and Recovery of Acidic Materials. L. U. Franklin to Gulf Oil Corporation.

Contaminated acid from hydrocarbon treatment, such as H_2SO_4, containing contaminants partly soluble in SO_3, is contacted with liquid SO_3 at a temperature below 30° F. in such proportions that no substantial quantity of the acid is dissolved in the SO_3. This treatment with SO_3 is repeated at a temperature above 70° F. in such proportions that all of the acid is dissolved in the SO_3. The temperature of the SO_3-solution is then lowered to less than 30° F. to separate the acid therefrom.

U.S.P. 2,562,804. Regeneration of an Iron Catalyst with Controlled CO_2:CO

Calculate it here...

...or calculate it there...

...you'll find it pays to make full use of **NATIONAL** *service on* **LEAD EQUIPMENT**

Are you primarily concerned with costs ... or with processing?

In either case, you can save time, worry and expense by using NATIONAL service on any and all chemical lead equipment: piping, tanks, fittings, valves.

Take lead valves, for example, either hard lead or lead-lined ...

With NATIONAL service, you benefit from the engineering know-how of the leader in lead. You get valves and fittings designed to make the most of lead's inherent corrosion resistance. Sold as "United" valves and "United Tubond" flanged pipe and fittings.

With NATIONAL service, you benefit from the widest sort of application knowledge.

NATIONAL men work on acid handling problems in many plants all over the country.

With NATIONAL service, you benefit from the resources of an organization that's NATIONAL in scope as well as in name. NATIONAL's strategically located plants and warehouses, its unexcelled sources of raw materials, its years of experience ... all add up to the kind of service you expect from the leader.

For lead valves or any other lead product ... remember the leader is NATIONAL.

Reg. U. S. Pat. Off.

NATIONAL LEAD COMPANY

New York 6; Atlanta; Baltimore 3; Buffalo 3; Chicago 8; Cincinnati 3; Cleveland 13; Dallas 2; Philadelphia 25; Pittsburgh 12; St. Louis 1; Boston 6 (National Lead Co. of Mass.); Los Angeles 23 (Morris P. Kirk & Son, Inc.); Toronto, Canada (Canada Metal Company, Limited)

Airetool single expansion tube cleaner for straight tubes. Excellent for removing heavy scale. Other types for curved tubes.
Airetool ball-bearing type tube expander for perfect expansion of tube ends into tube sheets.
They've Got 'Em
... POWER
... SAFETY
... SPEED
... DEPENDABILITY
AIRETOOL IS THE FIRST NAME IN TUBE MAINTENANCE EQUIPMENT

... CLEANERS
... EXPANDERS
... ACCESSORY TOOLS

To reduce your down-time, keep cleaning, keep rolling with AIRETOOL. For full details, write The AIRETOOL Mfg. Co., 316 S. Center St., Springfield, Ohio.

There's an AIRETOOL Tube Cleaner and Tube Expander for Every Type of Tubular Construction

AIRETOOL
MANUFACTURING COMPANY
SPRINGFIELD, OHIO

BRANCH OFFICES: NEW YORK, PHILADELPHIA, CHICAGO, HOUSTON, BATON ROUGE, TULSA

Patents

Ratios. Homer Z. Martin, Ivan Mayer and Charles W. Tyson to Standard Oil Development Company.

Carbonaceous deposits are removed from iron catalysts employed in Fischer-Tropsch syntheses without increasing the oxygen content of the iron. This is accomplished by treating contaminated catalyst in an atmosphere containing carbon oxides and essentially no free oxygen at temperatures above 1000° F. while correlating partial pressures of CO and CO_2 with temperature according to a specific formula. Carbonaceous material is oxidized with a predetermined quantity of oxidizing gas under conditions such that the flue gas formed will not burn iron.

U.S.P. 2,563,650. Method of Hardening Bauxite with Colloidal Silica. Heinz Heinemann to Porocel Corporation.

Thermally activated bauxite, suitable as an adsorbent, catalyst or catalyst support is physically strengthened by treating such bauxite granules, having an average pore diameter of 50-600A with a colloidal solution of silica of an average particle size of 100-600A. Between one and eight percent of silica are incorporated into the bauxite by various means of precipitation, such as drying, addition of an electrolyte salt, or changing the pH of the silica solution to a value outside the range 9.5 - 10.5.

CRACKING AND REFORMING

U.S.P. 2,562,225. Contacting Gaseous Materials with Fluidized Solids. H. P. Wickham and J. W. Moorman to M. W. Kellogg Company.

In a catalytic cracking or other conversion process, hot powdered catalyst is transferred from a first to a second contacting zone. The catalyst is maintained in the second zone as a dense, turbulent, suspended catalyst phase superimposed by a dilute catalyst phase by passing gases upwardly into this zone at low velocity. Catalyst is recovered from the dilute phase. More details are claimed.

U.S.P. 2,562,903. Cracking Apparatus. Frank J. Fontana to Houdry Process Corporation.

A cracking reactor or regenerator kiln is described in which uniformity and regularity of catalyst flow is established sooner and is more easily maintained than in the conventional reactors or regenerators.

ISOMERIZATION

U.S.P. 2,562,926. Isomerization of Hydrocarbons. H. R. Legatski to Phillips Petroleum Company.

A C_6 fraction comprising 65-85 percent n-hexane and 20-35 percent methyl cyclopentane is isomerized in the presence of an $AlCl_3$-hydrocarbon complex as catalyst and HCl as promoter. The reaction is carried out in a fractionation column, in which an overhead temperature of 210-375°, a kettle temperature of 285-425°F. and a pressure of 50-225 psi. is maintained. Hydrogen chloride is introduced at two points in the column and its concentration is maintained at 5-8 percent in the rectifying and 1-4 percent in the stripping

ALCOA

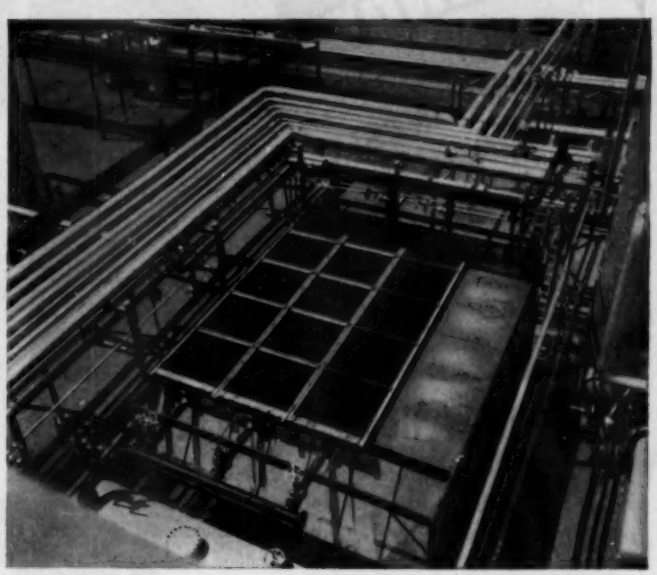
Published by Aluminum Company of America

Rearmament needs severely limit the manufacture of aluminum heat exchanger tubes. But we realize that the purchase of refinery and processing equipment requires long study of economic and performance factors. That is the reason for this message.

Skelly Oil Company Saves 50%

IN TUBE COSTS ON AIR COOLED EXCHANGERS

At their Eunice No. 2 gasoline plant near Eunice, New Mexico, Skelly Oil Company has installed a "Fin-Fan" air-cooled unit equipped with "aluminum tubes" and "aluminum fins" as a condenser for "Still Overhead Vapors." The company's engineers chose this type of condensing equipment because the atmosphere contained hydrogen sulfide and the vapors contained hydrogen sulfide and water in corrosive quantities. In addition there was a shortage of suitable cooling water. Aluminum tubes and fins were preferred to steel or Admiralty tubes with copper fins because of their resistance to hydrogen sulfide corrosion and lower investment cost. In this particular installation Fluor Fin-Fan designed equipment with Griscom-Russell K finned aluminum tube sections was used. The aluminum tubes are rolled into cast-iron headers and no cathodic protection has been necessary. These units have been in service for over two years—show no sign of corrosion—should last 12 to 15 years based on past experience with aluminum.



ALCLAD TUBES . . .

a bargain in cooling water corrosion resistance

HOW THEY WORK

The thin zinc-aluminum alloy internal layer galvanically resists corrosion of the base aluminum alloy structure of the tube—acts like a "built-in" anode. Corrosion is confined within the integral cladding layer. Even when large areas of the Alclad coating have been destroyed by electrolysis, the rest of the coating still protects the exposed alloy core. Alclad Tubes have withstood such corrosive attack for more than 17 years.

WHAT THEY COST

Foot for foot, metal for metal, Alclad Tubes cost less than any other tubes except bare aluminum. 20% less than ordinary steel. 47% less than Admiralty brass. 83% less than stainless steel.

ALCOA OFFERS BOOKLET

This 24-page booklet will answer many of your questions about Alcoa Tubes. It covers fabrication techniques, alloy selection, chemical and petroleum applications. It describes tube cleaning, inhibitors, cathodic protection. It contains complete information on fluid flow and heat transfer. There are formulas, tables and specification data. Write for your free copy today. ALUMINUM COMPANY OF AMERICA, 1864K Gulf Building, Pittsburgh 19, Pennsylvania.

. . . NEW Heat Saving Efficiency

MUNDET 85% MAGNESIA INSULATION provides maximum strength and resistance to vibration. Extra durability is built into this insulation. In pipe covering and blocks, it is precision manufactured on the latest type of automatic equipment to insure uniform standards. It does not "powder", settle or disintegrate. It is unaffected by steam or water leakage. It maintains an attractive, smooth finish. Precision pipe fit is assured, with no spaces left for the escape of heat. You benefit from the most modern manufacturing facilities for the production of heat insulation when you specify Mundet 85% Magnesia Pipe Covering and Blocks.

Write for new heat insulation Engineering & Specification Data Manual.

Mundet Cork Corporation

Insulation Division, 7309 Tonnelle Ave., North Bergen, N. J.

Mundet district offices are located in these cities:

ATLANTA 339-41 Elizabeth St., N.E.	**DALLAS 10** 601 Second Ave.	**JACKSONVILLE 6, FLA.** 800 E. Bay St.	**NEW ORLEANS 16** 315-25 N. Front St.
BALTIMORE 30 612 Battery Ave.	**DETROIT 21** 14401 Prairie Ave.	**KANSAS CITY 7, MO.** 1401 St. Louis Ave.	**NEW YORK 17** 331 Madison Ave.
BOSTON 57 Regent St., N. Cambridge 40	**HOUSTON 1** Commerce and Palmer Sts.	**KNOXVILLE** 1221 Grand Ave.	**PHILADELPHIA 39** 856 N. 48th St.
CHARLOTTE 3, N. C. 307 S. Cedar St.	**INDIANAPOLIS 4** 15 E. Washington St.	**LOS ANGELES** (Haywood): 6116 Walker Ave.	**ST. LOUIS 9** 3176 Brannon Ave.
CINCINNATI 2 427 West 4th St.	**In Canada:** Mundet Cork & Insulation, Ltd., 35 South Ave., Toronto		**SAN FRANCISCO 7** 440 Brannon St.

INSULATION FOR HIGH & LOW TEMPERATURE

Patents

section. Iso-hexanes are removed from the overhead and cyclohexane from the bottoms.

U.S.P. 2,563,051. Production of Motor Fuel and Drying Oil by Hydrogen Fluoride Polymerization and Alkylation. Carl B. Linn to Universal Oil Products Company.

A process is described which comprises subjecting a charging stock predominating in an olefin containing from 3-8 C atoms per molecule to the reaction of HF at relatively severe conjunct polymerization conditions, thereby to form a HF-hydrocarbon complex, isobutane and higher boiling upper-layer hydrocarbons. The isobutane is separated and alkylated with an olefin containing from three to eight C atoms per mol in the presence of HF at alkylating conditions.

U.S.P. 2,563,087. Separation of Thiophene by Selective Alkylation. J. A. Vesely to Universal Oil Products Company.

A mixture of thiophene with benzene or toluene is selectively alkylated with an olefin-acting alkylating agent, such as isobutylene, in the presence of a phosphoric acid catalyst at a temperature of 10-30° C., whereby the thiophene only is alkylated. The resultant mixture is fractionally distilled to separate unreacted aromatic hydrocarbon from the alkylated thiophene.

POLYMERIZATION AND CONVERSION

U.S.P. 2,560,604. Manipulation of Fluent Solids. H. A. Shabaker to Houdry Process Corporation.

In a method for the introduction into a contacting zone of fluent solid particles varying in size over a range such that flowing the particles down an inclined path results in a non-uniform distribution of particles of the same size over the cross-section of the mass, the particles are supplied to a body thereof located above the contacting zone and are discharged from the bottom of this body at multiple points. The discharged particles are moved downwardly in compact non-turbulent flow to the surface of a non-turbulent bed of the particles in the contacting zone. The total horizontal area for the particle flow is expanded in the course of the movement in a special manner.

U.S.P. 2,560,741. Polyethylene Polyamine Activated Organic Peroxide Catalyzed Synthetic Rubber Emulsion Polymerizations. R. L. Provost to U. S. Rubber Company.

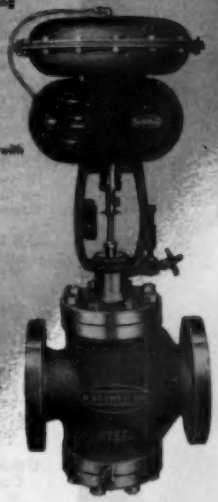
An alkaline aqueous emulsion of butadiene-1,3 or a mixture thereof with compounds containing a single $CH_2{=}C<$ group is polymerized in the presence of an organic peroxide catalyst, a polyethylene polamine activator, and an emulsifier. The polymerization is carried out in the presence of 0.001-0.1 part of alkali salt of ethylenediamine tetraacetic acid per 100 parts of polymerizable monomers.

U.S.P. 2,560,767. Distillation of Carbonaceous Solids. L. C. Huff to Universal Oil Products Company.

Indicating, non-indicating and recording pressure or temperature controllers.

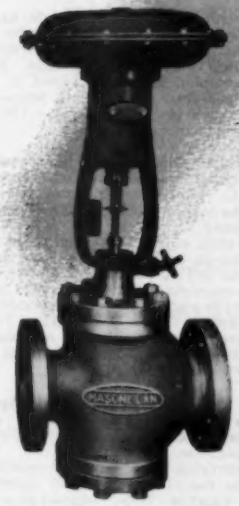
12000 Series Liquid Level Controller.

Model 2707 Pressure Controller mounted on control valve.



10000 Series Control Valve with Series 7400 Positioner.

10000 Series Control Valve.



Mason-Neilan

Serves the Process Industries with Accurate and Reliable Control Equipment

Since 1882 Mason-Neilan has supplied industry with a wide variety of standard and specialized automatic control equipment for process and associated services. Each is a development of practical engineering based on experience gained in close contact with industrial control problems. Each is specifically designed to do an exceptional job. With Masoneilan products you get engineered equipment that assures superior performance, long life with minimum maintenance.

Industrial Control MASONEILAN *Specialists Since 1882*

MASON-NEILAN REGULATOR COMPANY

1182 Adams Street, Boston 24, Mass.

Sales Offices or Distributors in the Following Cities:
New York • Syracuse • Chicago • St. Louis • Tulsa
Houston • Pittsburgh • Atlanta • Cleveland • Cincinnati • Detroit • San Francisco • Salt Lake City • El Paso • Philadelphia • Boise • Albuquerque
Charlotte, N. C. • Los Angeles • Denver • Appleton, Wisconsin • Corpus Christi • New Orleans Mason-Neilan Regulator Co., Ltd., Montreal and Toronto

Patents

Details are claimed of a process for producing valuable hydrocarbon liquids and gases from hydrocarbonaceous solids, such as oil shales, tar sand, and the like by treatment in several distillation zones.

U.S.P. 2,560,899. Process and Apparatus for the Catalytic Conversion of Hydrocarbons. E. W. Shand to Sinclair Refining Company.

In a fluid catalyst hydrocarbon conversion in which the charge oil is passed upwardly in vapor phase through a dense fluidized body of catalyst with a superimposed dispersed phase in a reaction zone and the continually withdrawn catalyst is recycled after regeneration in suspension in charge oil vapors, the regenerated catalyst is mixed with the liquid charge oil under superatmospheric pressure, whereupon this pressure is suddenly reduced to flash the oil into vapors.

U.S.P. 2,561,266. Method of Polymerizing Olefins at Subatmospheric Temperatures. J. M. Powers to Standard Oil Development Company.

A mixture of tertiary mono-olefin and a diolefin with 4-8 atoms is polymerized at a temperature of —120° to —175°F. in the presence of a Friedel-Crafts catalyst solution at a pressure no greater than one psi. A rubbery polymer is formed.

U.S.P. 2,561,313. Unsaturated Oil-Soluble Copolymers. T. B. Malinowski to Monsanto Chemical Company.

A mixture of 2-8 mol proportions of alpha-methyl styrene and one mol proportion of maleic anhydride is reacted at a temperature of 0-85°C. in the presence of fuller's earth. An unsaturated oil-soluble copolymer is formed.

U.S.P. 2,561,334. Method of Hydrocarbon Conversion to Lower Boiling Hydrocarbons and Coke. V. O. Bowles and A. H. Schutte to The Lummus Company.

Details are claimed of a method of converting heavy hydrocarbons into coke and lighter hydrocarbons with the use of a relatively deep, free-flowing, continuous column of preheated coke particles. The charge is spread over these particles at points within the upper part of the moving column in concurrent direction therewith.

U.S.P. 2,561,419. Process for Producing Gas from Oil. A. H. Schutte to The Lummus Company.

Details are claimed of a process of reducing heavy liquid hydrocarbons to large yields of commercial heating gas in the presence of a freely-flowing, continuous, gravity-packed column of preheated particles of coke.

U.S.P. 2,561,420. Continuous Hydrocarbon Conversion Process and Apparatus. A. H. Schutte to The Lummus Company.

Heavy residual hydrocarbons are converted into maximum yields of more valuable liquid products and minimum yields of coke by applying the charge preheated to a temperature in excess of 700°F. to a continuously moving gravity-packed column of particle-form solids. Details of the process are claimed.

U.S.P. 2,561,729. Polymerization of Isoolefins with Complex Friedel-Crafts Metal Halide Catalysts. R. W. Dornte to Standard Oil Development Company.

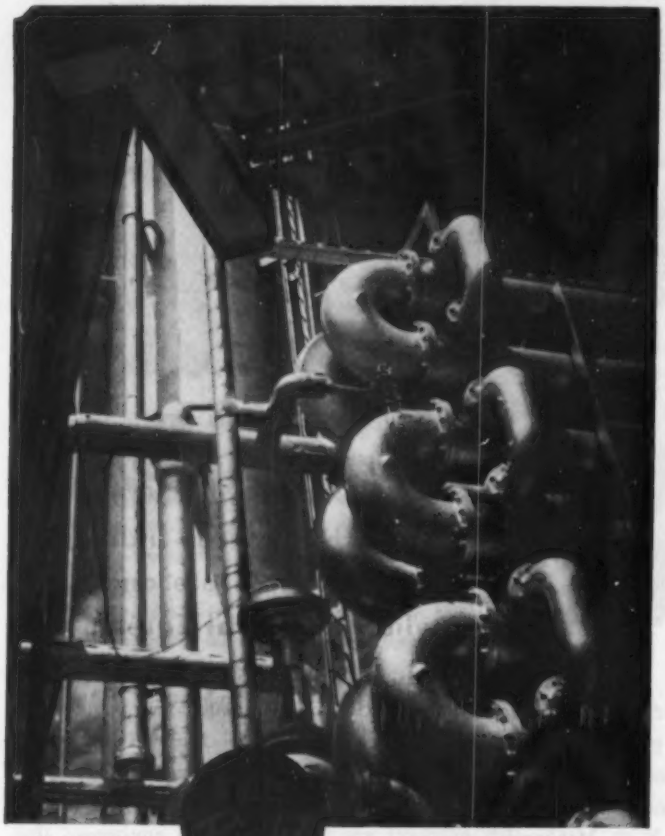
A Friedel-Crafts metal halide catalyst is mixed with up to ten moles of one of a number of complex forming substituted ethylene compounds. The liquid complex formed is added to an isobutylene feed cooled to a temperature between ten degrees and —164°C. A solid polymer is formed.

U.S.P. 2,561,796. Olefin-Haloaromatic Copolymer and Preparation Thereof. W. C. Hollyday, Jr., and W. J. Sparks to Standard Oil Development Company.

A mixture of 70-99.7 percent of an aliphatic olefin with not more than eight C atoms and 30-0.3 percent by weight of a mono-olefinic ring-halogenated aromatic hydrocarbon is copolymerized at a temperature below 0°C. with a Friedel-Crafts catalyst. Solid oil-soluble products of a molecule weight of at least 1000 are obtained.

U.S.P. 2,561,852. Process and Apparatus for Catalytic Reactions and Adsorptions. S. R. Funsten to Filtrol Corporation.

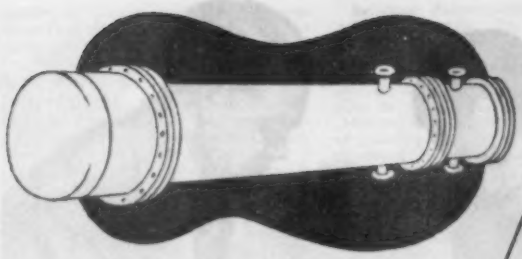
In carrying out catalytic reactions with the use of a plurality of superimposed catalyst beds, introduction of catalyst into the upper bed and discharge of spent catalyst from the lower bed, the catalysts are rabbled on each bed by rotating rabbling arms. Reactant vapors and gases are introduced into the rotating arm on lower beds and discharged from these arms at a



NATURAL GASOLINE PLANTS

- *Oil Refinery Equipment*
- *Steel Plate Fabrication*
- *Structural Steel*
- *Chemical Processing Equipment*

FLINT STEEL CORPORATION
TULSA, OKLAHOMA

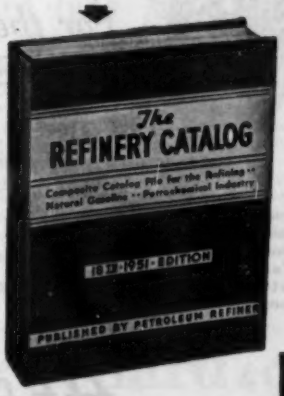


who can fabricate *to order?*

THE REFINERYMAN'S "BUYING GUIDE" HAS THE INFORMATION

Fifteen fabricators of exchangers have their catalogs filed in Refinery Catalog. Whether your problem is exchangers or one of many others, you'll find all the better known manufacturers in this easy-to-use catalog.

In a matter of minutes you can find the information you want on approximately 2,000 different types of processing equipment . . . all listed in one handy volume that takes up little space on your desk top.



REFINERY CATALOG

THE UNIVERSAL EQUIPMENT GUIDE FOR REFINERY BUYERS

ASK THE AEROFIN MAN

For the Practical Answer to Your Heat-Exchange Problem . . .

There is a competent Aerofin heat-transfer engineer near you, qualified by intensive training and long experience to find the *right* answer to your own particular heat-exchange problem.

This specialized knowledge is there, ready for you to use to your greatest advantage. Ask the Aerofin man — and be right.

Aerofin is sold only by manufacturers of nationally advertised fan system apparatus. List on request.

AEROFIN CORPORATION
410 South Geddes St., Syracuse 1, N. Y.

plurality of points as the rotating arm passes through the bed. Reactant vapors withdrawn from one bed are introduced into the rotating arms of the next higher bed.

U.S.P. 2,562,217. Combination Process for the Production of Saturated Hydrocarbons. L. Schmerling to Universal Oil Products Company.

A paraffin with more than two C atoms is reacted with less than the mol amount of a polychloromonoolefin in the presence of a peroxy compound catalyst at a temperature at least as high as the decomposition temperature of the catalyst and a pressure such that a substantial portion of the reactants is in the liquid phase. Higher chloroolefin thus produced in addition to HCl is reacted with an isoparaffin in the presence of a Friedel-Crafts catalyst at a temperature of —30° to 100° C. and corresponding pressure to form a saturated hydrocarbon of greater molecular weight than the first-named paraffin.

U.S.P. 2,562,369. Condensation of Saturated Hydrocarbons with Chloroolefins. L. Schmerling to Universal Oil Products Company.

The process of this patent is related to that of U.S.P. 2,562,217. One mol of the paraffin is here reacted under similar conditions with one mol of a polychlorooleﬁn having at least one Cl atom attached to each of the doubly bonded C atoms. The reaction temperature shall be high enough to split off one mol proportion of HCl. Unsaturated chlorinated hydrocarbons are obtained.

U.S.P. 2,562,944. Emulsion Polymerization of Diolefins in the Presence of Selected Polymerization Regulators. C. H. Portser, Jr., to Armstrong Cork Company.

An open-chain aliphatic conjugated diolefin is emulsion copolymerized with styrene, or methyl styrene, or acrylonitrile in the presence of an aromatic aldehyde and a hydroxy carboxylic acid of 2-8 C atoms. A synthetic rubber is produced.

U.S.P. 2,562,993. Apparatus for Effecting Catalytic Reactions. Eugene E. Sensel and Roland A. Beck to The Texas Company.

A reactor is described which maintains the catalyst in a fluidized state within the reaction zone during conversion, irrespective of the density of the catalyst used and the contraction of vapors occurring as a result of the reaction.

U.S.P. 2,563,074. Production of Spirohydrocarbons. Louis Schmerling to Universal Oil Products Company.

Spirohydrocarbons are produced by condensing a cycloalkadiene and a dihaloalkane of the structure

$$X-\underset{R'}{\overset{R}{C}}-(\underset{}{C})n-\underset{R'''}{\overset{R''}{C}}-X$$

where R, R', R" and R"' consist of hydrogen and alkyl radicals, X is a halogen and is an integer from 1—5, and the unsatisfied valances of the group C-(C)n—C are combined with hydrogen or an alkyl radical. Alpha, omega-dihaloalkane may be condensed with an addition compound of cycloalkadiene.

Patents

U.S.P. 2,563,624. Method of Cleaning Isobutylene Polymerization Apparatus. A. B. Small and G. F. Sellen to Standard Oil Development Company.

Details are claimed of a process for the polymerization of a major proportion of isobutylene and a minor proportion of isoprene in the presence of methylchloride diluent, in the presence of $AlCl_3$ in the methyl chloride solution as the catalyst. A non-volatile amine is employed as a catalyst destroyer and an oxidation inhibitor.

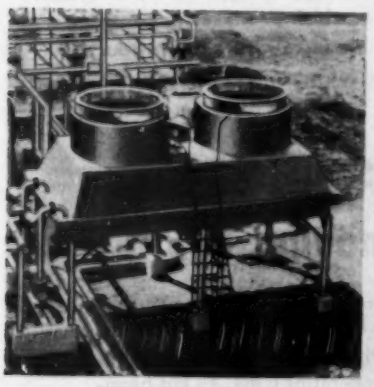
U.S.P. 2,563,631. Method of Preparing Liquid Copolymers of Ethylene and Styrene. David W. Young and William H. Smyers to Standard Oil Development Company.

Ethylene and styrene are copolymerized by contact in gaseous form with an alkyl solution of a Friedel-Crafts catalyst at 0—20°C. and 2—5 atmospheres pressure.

HEAVY OILS AND WAXES

U.S.P. 2,560,542. Clean-Burning Carbonaceous Compositions. J. D. Bartleson and E. C. Hughes to The Standard Oil Company of Ohio.

A mineral lubricating oil has dispersed therein 0.25-0.50 percent by weight of chromium naphthenate, 0.25 percent-0.50 percent of maganese naphthenate or copper oleate, and one percent of the re-



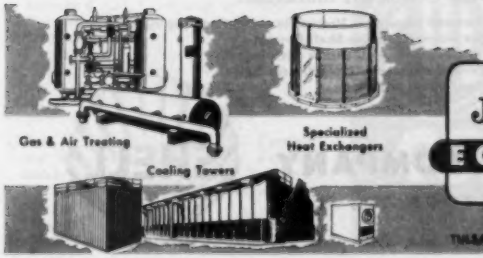
Only Thorough Engineering and Adequate Sizing Can Give You Pritchard Quality!

New Pritchard Type "B" QUINTAIR*

Air Cooled Heat Exchanger

Pritchard *quality* means a lot when it comes to selecting air cooled heat exchangers. Take Pritchard's Type "B" Quintair* for example. All parts requiring attention are readily accessible and easily serviced. Thoroughly engineered for long life and operating economy—adequately sized for top performance under the most exacting conditions—the Pritchard Type "B" Quintair* can handle one or several different heat loads in a single compact unit. Whatever your cooling problem, it will pay you to investigate the Pritchard Type "B" Air Cooled Heat Exchanger. *Write today for full information.*

*Registered Trade Name



J.F. Pritchard & Co.

EQUIPMENT DIVISION

Dept. No. 188 908 Grand Ave., Kansas City 6, Mo.

Pioneers of QUALITY Specialized Process EQUIPMENT

District Offices: CHICAGO • HOUSTON • NEW YORK • PITTSBURGH
TULSA • ST. LOUIS • Representatives in Principal Cities from Coast to Coast

In spite of record output

Sulphur is SHORT

For the first time since World War I, sulphur is in short supply . . . a condition which promises to continue and to affect the products of many industries.

Commercial sulphur in quantity is just one advantage of this method for removing H_2S

SULPHUR IS A MARKETABLE and profitable side-product of the Shell Phosphate Process for dependable, low-cost removal of H_2S in the presence of large volumes of CO_2. Since the recovered H_2S is of relatively high concentration, it can be converted to solid sulphur or acid at very low cost.

This treating process has no harmful effect upon subsequent refining operations. The treating agent is inorganic . . . non-contaminating to hydrocarbons.

The Shell Phosphate Process is outstanding for its low operating costs. All but harmless amounts of H_2S are removed while most of the CO_2 is left untouched.

The Shell Phosphate Process is available to any operator under license from the Shell Development Company . . . together with experienced engineering service for its design, and operation.

SHELL DEVELOPMENT COMPANY

50 WEST 50TH STREET • NEW YORK 20, N. Y.

SHELL

action product of P_2S_5 with hydrogenated sperm oil. This lubricating composition is relatively clean-burning and stable against oxidative deterioration at temperatures up to crank case temperatures.

U.S.P. 2,560,543. Method of Processing Lubricating Oil by Treating with a Phosphorus Sulfide and the Resulting Products. J. D. Bartleson to The Standard Oil Company of Ohio.

A lubricating hydrocarbon stock is treated with 0.1-0.75 percent by weight of a phosphorus sulfide at a temperature of 275-450° F. to inhibit essential oxidation in service.

U.S.P. 2,560,544. Method of Processing Lubricating Oil by Treating with Sulfuric Acid, a Phosphorous Sulfide and Clay, and the Resulting Product. J. D. Bartleson to The Standard Oil Company of Ohio.

The process of this patent differs from that of U.S.P. 2,560,543 only in that the hydrocarbon stock is refined with H_2SO_4 and then treated with clay before the treatment with a phosphorus sulfide.

U.S.P. 2,560,545. Method of Processing Lubricating Oil by Solvent-Extraction and Treating with a Phosphorus Sulfide and Clay and the Resulting Products. J. D. Bartleson to The Standard Oil Company of Ohio.

The H_2SO_4 refining according to U.S.P. 2,560,544 is here replaced by a solvent-refining, and the clay-treatment is executed subsequently. The process is otherwise identical with that of the other patent.

U.S.P. 2,560,546. Method of Processing Solvent-Extracted Lubricating Oil by Treating with Phosphorus Pentasulfide and a Base and the Resulting Products. J. D. Bartleson to The Standard Oil Company of Ohio.

The process according to this patent differs from that of U.S.P. 2,560,545 in that the solvent-extracted stock is treated with 0.1-0.75 percent by weight of P_2S_5 at a temperature of 275-450° F. and then with 0.25-6.0 equivalents of a base per mol of the P_2S_5.

U.S.P. 2,560,547. Method of Processing Lubricating Oil by Treating with Sulfuric Acid, a Phosphorus Sulfide and a Base and the Resulting Products. J. D. Bartleson to The Standard Oil Company of Ohio.

The process according to U.S.P. 2,560,544 is here improved only by the addition of a treatment of the end-product of said process with 0.25-6.0 equivalents of a base per mol of the sulfide employed.

U.S.P. 2,560,548. Method of Processing Solvent-Extracted Lubricating Oil by Treating with a Phosphorus Sulfide, a Base and Clay and the Resulting Products. J. D. Bartleson to The Standard Oil Company of Ohio.

The process according to this patent differs from those of U.S.P. 2,560,543 to 547 in that the hydrocarbon stock after the phosphorus sulfide treatment is subjected to the base treatment, and that a separate clay treatment is included subsequent to the sulfide treatment.

U.S.P. 2,560,588. Mineral Oil Containing Polymers of Esters of Fumaric Acid. J. C. Munday and D. T. Rogers to Standard Oil Development Company.

A waxy mineral lubricating oil contains a minor amount of a polymer of fumarate alkyl ester composition having more than one distinct alkyl ester group with 1-18 C atoms. At least one of these ester groups shall have a chain length of more than ten C atoms. The polymer shall have a molecular weight of 1,000-40,000 and shall be formed in a special manner. The additive has pour point depressing characteristics.

U.S.P. 2,560,773. Synthetic Wax of Carnauba Type. S. P. Lovell to Lovell Chemical Company.

A microcrystalline petroleum wax prepared by oxidizing petroleum tankage is mixed with molten polyethylene in certain proportions. The temperature of the mixture is raised to about 400° F. while stirring. Upon cooling a yellowish brown wax of a m.p. of about 216° F. and 0.9307 specific gravity is obtained which is soluble in hot hydrocarbon solvents.

U.S.P. 2,560,956. Mineral Oil Compositions Containing Polymers of Thiophene. G. C. Johnson to Socony-Vacuum Oil Company, Inc.

A mineral lubricating oil contains a small amount of a polymer of thiophene or monoalkyl thiophenes obtained at a temperature of 20-200° C. in the presence of a silica-alumina catalyst. The additive improves the viscosity index of the oil.

U.S.P. 2,560,986. Mineral Oil Compositions Containing Petroleum Wax Carboxylic Acids. F. P. Richter to Socony-Vacuum Oil Company, Inc.

A mineral oil contains a minor amount

for the REFINERIES and PETRO•CHEMICAL PLANTS of the GULF COAST

We offer a highly specialized manufacturing service to meet your needs for...

- LACQUERS and
- INDUSTRIAL FINISHES

Our intimate contact with the huge chemical plants of the Gulf Coast enables us to serve the petroleum industry more effectively and economically. May we discuss your needs?

CPL

COAST Paint & Lacquer Co. Inc.

P. O. BOX 1113, HOUSTON 1, TEXAS

Patents

of a Ba or Mg salt of a product prepared by a special process from a wax-like hydrocarbon mixture. The additive improves the detergent properties of the oil.

U.S.P. 2,561,733. Lubricating Oil Compositions Containing the Reaction Products of Diesters of Dithiophosphoric Acid and Pinene. F. B. Augustine to Socony-Vacuum Oil Company, Inc.

A lubricating oil contains a minor proportion of a product obtained from the reaction between one mol of a diester of dithiophosphoric acid and one mol of a pinene at elevated temperature. The additive improves the characteristics of the oil, such as resistance against corrosion and sludge formation.

U.S.P. 2,561,780. Mineral Oil Compositions Containing Thienylthioalcohols. J. W. Brooks to Socony-Vacuum Oil Company, Inc.

A mineral oil contains a minor proportion of a beta-thienylthioalcohol. The additive stabilizes the oil against oxidation.

U.S.P. 2,562,776. Lubricant Additive. E. B. Cyphers and J. H. Bartlett to Standard Oil Development Company.

A mineral base lubricating oil is compounded with 0.02-20 percent by weight (of the whole composition) of the oil soluble condensation product of a C_8-C_{32} dialkylated dithiophosphate salt of alkali metal condensed at a temperature of 100-200° F. with a copolymer of C_8-C_{32} aliphatic chlormaleate with vinyl acetate produced in a special manner. The additive improves the viscosity index of the oil, depresses its pour point and imparts extreme pressure characteristics thereto.

U.S.P. 2,562,800 Lubricant Composition of Mineral Oil Containing a Condensation Product of Aliphatic-Aromatic Ketone and a Sulfur Chloride. E. Lieber to Standard Oil Development Company.

A normally non-volatile hydrocarbon material contains a pour depressing amount of an oil-soluble product obtained by reacting special amounts of an aliphatic-aromatic ketone, the aliphatic hydrocarbon component of which has more than 10 C atoms, and a sulfur chloride in the presence of a Friedel-Crafts catalyst at a temperature of 80-200° F. and further treating the reaction product.

U.S.P. 2,562,808. Wax Phenol Ester of Substituted Succinic Acid and Wax Mineral Oil Compositions Containing Same. L. A. Mikeska to Standard Oil Development Company.

A major proportion of a waxy mineral lubricating oil is compounded with a pour depressing amount of a wax phenol ester of a substituted succinic acid. The substituent group of this acid is a hydrocarbon group with 12-18 C atoms.

U.S.P. 2,562,814. Sulfonate Lubricating Grease. R. O'Halloran to Standard Oil Development Company.

A lubricating oil is thickened to grease consistency with a complex of 5-20 percent by weight (based on the total composition) of oil-soluble metal sulfonate derived from relatively high molecular weight petroleum sulfonic acids combined with 0.5-15 percent by weight of an oil-soluble metal salt of relatively low molecular weight, acid, and 0.1-5 percent of an ester of polyhydric alcohol and organic acid of 12-24 C atoms as a structure modifier.

U.S.P. 2,562,829. Extreme Pressure Lubricant Containing Manganese Naphthenate as an Antirust Agent. L. W. Sproule and L. F. King to Standard Oil Development Company.

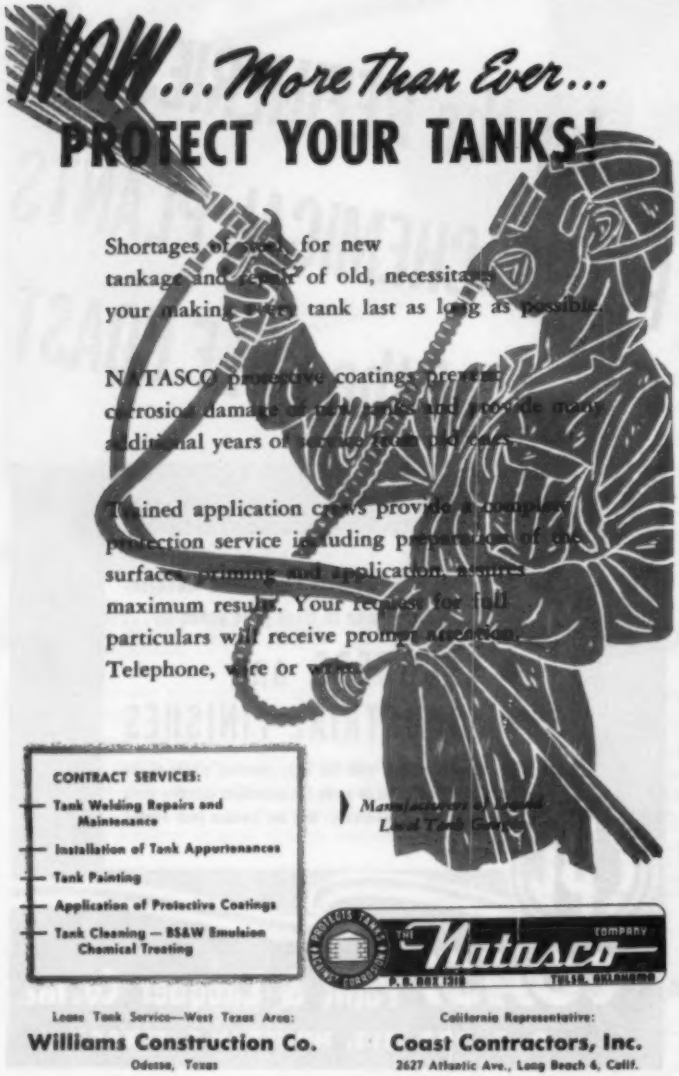
An extreme pressure lubricating composition consists of 80-82.5 percent by weight of mineral base lubricating oil, ten percent of sulfurized and phosphorus sulfide treated fatty oil, five percent chlorinated hydrocarbon of 40 percent Cl content, and 2.5-5 percent of manganese naphthenate. The hydrocarbon of the chlorinated compound shall have an average molecular weight at least as high as kerosene.

U.S.P. 2,562,902. Method of Testing Wax. K. A. Fischer, Washington, D. C.

The oil content of waxes is determined by the addition of an oil-soluble, crystallizable dye stuff which is soluble in liquid wax but insoluble in crystallized wax. The dye is incorporated in the liquid wax material, whereupon the wax is solidified and the color change of the dye is determined.

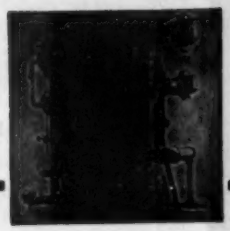
U.S.P. 2,562,904. Lubricating Oil Composition. M. W. Freeman, Detroit.

A mineral lubricating oil contains special amounts of (a) a certain reaction product of an amine and a higher


NOW...More Than Ever...
PROTECT YOUR TANKS!
Shortages of steel for new tankage and repair of old, necessitate your making every tank last as long as possible.
NATASCO protective coatings prevent corrosion damage of tank steel and provide many additional years of service from old tanks.
Trained application crews provide a complete protection service including preparation of the surface, priming and application of coats for maximum results. Your request for full particulars will receive prompt attention. Telephone, wire or write
CONTRACT SERVICES:
Tank Welding Repairs and Maintenance
Installation of Tank Appurtenances
Tank Painting
Application of Protective Coatings
Tank Cleaning — BS&W Emulsion Chemical Treating
Manufacturers of Natasco Lined Tank Coatings
The Natasco Company
P. O. BOX 1318 TULSA, OKLAHOMA
Lease Tank Service—West Texas Area:
Williams Construction Co.
Odessa, Texas
California Representative:
Coast Contractors, Inc.
2627 Atlantic Ave., Long Beach 6, Calif.

IS VACUUM THAT'S 99.99% PERFECT

good enough for your process?



THIS degree of vacuum is easily obtained with the Croll-Reynolds four or five-stage steam jet EVACTOR, with no moving parts. Each stage from a technical standpoint is as simple as the valve that turns it on. Numerous four-stage units are maintaining industrial vacuum down to 0.2 mm. and less, and many thousands of one, two and three-stage units are maintaining vacuum for intermediate industrial requirements on practically all types of processing equipment.

By permitting water, aqueous solutions or any volatile liquid to evaporate under high vacuum and without heat from an outside source, enough BTU's can be removed to chill the liquid down to 32° F., or even lower in the case of solutions. This is the principle of the Croll-Reynolds "Chill-Vactor." Hundreds of these have been installed throughout the United States and in several foreign countries.

An engineering staff of many years experience has specialized on this type of equipment and is at your service. Why not write today, outlining *your* vacuum problem?

CR REYNOLDS

CROLL-REYNOLDS CO., INC.

17 JOHN STREET, NEW YORK 38, N. Y.

Chill-Vactors Steam Jet Evactors Condensing Equipment

OIL AND GAS BURNING EQUIPMENT FOR EVERY INDUSTRIAL APPLICATION

Whether you burn pitch, tar, oil, gas or a combination of these fuels, there's a NATIONAL AIROIL BURNER for your job.

Our more than 39 years' experience in the design, development and manufacture of all types of industrial burners is at your service.

Ask us about your requirements . . . we'll gladly give you full information.

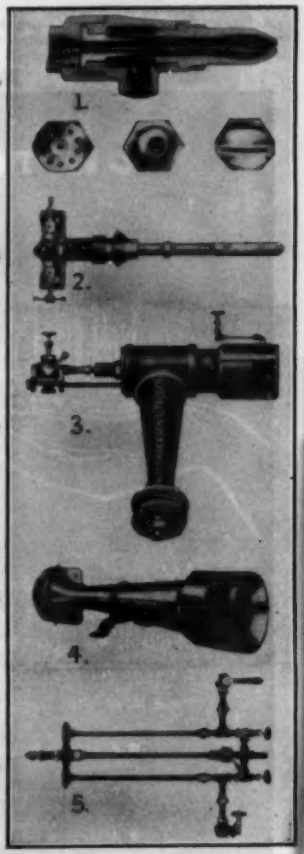
1. TYPE "SA"
(For use where steam is available) *atomizes thoroughly* and *burns completely*, the lowest and cheapest grades of fuel oil and tar, requiring only low oil pressure and temperatures.
Send for Bulletin No. 21.

2. TYPE "S-A-L"
(Large capacity burner similar to TYPE "S-A-R") is adaptable in combination with powdered coal burners in large boilers.
Send for Bulletin No. 24.

3. COMBINATION GAS AND OIL BURNER
—the "AIROCOOL" Gas Burner in combination with a TYPE "S-A-R" Oil Burner.
Send for "AIROCOOL" Brochure.

4. "AIROCOOL" GAS BURNER
(Of venturi type), assures low turndown without burnback.
Send for "AIROCOOL" Brochure.

5. TYPE "S-A-D"
(Refuse Oil Burner) burns acids or caustic oils, sludges, asphalts, tank bottoms, polymer oils, heavy petrolatums, organic oil residuums, waste cutting oils, sulphite pulp liquors, etc., in combination with fuel oil.
Send for Bulletin No. 21.



PRODUCTS

OIL BURNERS and GAS BURNERS for industrial power, process and heating purposes; STEAM ATOMIZING OIL BURNERS; MOTOR-DRIVEN ROTARY OIL BURNERS; MECHANICAL PRESSURE ATOMIZING OIL BURNERS; LOW AIR PRESSURE OIL BURNERS; GAS BURNERS; COMBINATION GAS and OIL BURNERS; AUTOMATIC OIL BURNERS, for small process furnaces and heating plants; FUEL OIL HEATERS; FUEL OIL PUMPING and HEATING UNITS; FURNACE RELIEF DOORS; AIR INTAKE DOORS; OBSERVATION PORTS; SPECIAL REFRACTORY SHAPES.

NATIONAL AIROIL BURNER CO., INC.

Main Office & Factory: 1254 EAST BEDDLEY AVENUE
PHILADELPHIA 34, PA.
SOUTHWESTERN DIVISION: 2512 SOUTH BOULEVARD
HOUSTON 6, TEXAS

fatty acid, and (b) of an oxidized-phosphorized-sulfurized petroleum sulfonate or sulfonated castor oil obtained by a special process. Both the reaction products (a) and (b) are coreacted until a homogeneous product is obtained. The lubricant withstands wide temperature changes without marked change in consistency.

U.S.P. 2,563,013. Preparation of Lubricating Compositions. M. Duke, J. Rio, and C. Hohing, Jr., to Celanese Corporation of America.

A lubricating composition is prepared from a mineral oil and dehydrated and desalted sulfonated fatty materials by first distilling the water from the sulfonated fatty materials containing water and inorganic salts, and then blending these sulfonated materials with the mineral oil whereby the inorganic salts are precipitated.

U.S.P. 2,563,583. Soluble Cutting Oils. T. W. Dixon to Standard Oil Development Company.

A soluble cutting oil consists of 20-70 percent mineral oil, 10-50 percent petroleum sulfonate, 2-15 percent rosin soap, 1-5 percent of C_3-C_4 glycol monoalkyl ether, 0.01-0.1 percent of a silicone polymer, and 0.005-0-2 percent of a lower alkylol amine, phenyl amine or cyclohexyl amine. The ether works as a neutral solvent and the amine as a modifier for dispersing the silicone polymer in the oil.

U.S.P. 2,563,609. Lubricating Oil Additives. A. H. Matuszak to Standard Oil Development Company.

A mineral lubricating oil contains 0.1-10 percent of pentaerythritol monooleate monoalkylcarbonate. The composition inhibits rusting and corrosion of metal parts exposed to moisture.

HYDROGENATION, DEHYDROGENATION, AROMATIZATION

U.S.P. 2,561,244. Hydrogenation of Oxides of Carbon to Produce High Boiling Alcohols and Liquid Hydrocarbons. S. B. Sweetser to Standard Oil Development Company.

Normally liquid hydrocarbons and higher boiling alcohols are produced from a dried, CO/H_2 mixture in the presence of a fluidized reduced iron catalyst and a promotor. The formation of this catalyst is claimed in detail. Special synthesis conditions are maintained in the reaction zone.

U.S.P. 2,561,530. Low-Pressure Hydrogenation Process. C. W. Montgomery to Gulf Research and Development Company.

In a process for hydro-desulfurization of hydrocarbons, use is made of a contact material prepared from a transition group metal or its oxides on a porous carrier. The contact mass employed shall be less than about 8/10 of a statistical monolayer of said metal evenly distributed on the carrier surface and shall be determined by special characteristics claimed, to reduce decrepitation of the contact.

U.S.P. 2,562,806. Hydrocarbon Synthesis with Catalyst Reconditioning. Ivan Mayer to Standard Oil Development Company.

Fresh iron type hydrocarbon synthesis catalyst is pretreated to retard coke formation and physical disintegration during synthesis. The pretreatment is carried out with CO_2-free effluent gas containing H_2 and CO from hydrocarbon synthesis reaction for a sufficient period of time to convert a substantial portion of the iron to iron carbide. Formation of CO_2 and iron oxide in the pretreat zone is suppressed by use of high gas space rates.

U.S.P. 2,562,980. Process for Upgrading Diesel Fuel. Harold V. Atwell to The Texas Company.

Olefin containing Diesel oil from a hydrocarbon synthesis is upgraded by contacting it with CO and H_2 at 100-350° F. and 100-5000 psi. in the presence of a catalyst containing a metal of the iron group. Olefins are oxygenated and oxygen containing compounds hydrogenated. Oxygen containing compounds are separated from the Diesel oil by means of an adsorbent.

U.S.P. 2,562,989. Upgrading Olefinic Stocks. Ernest A. Naragon to The Texas Company.

Olefinic gasoline fractions are upgraded by combined hydrogenation and isomerization in the presence of a catalyst consisting of alumina of low sodium content containing both molybdena (5 percent) and boria (10 percent). The alumina is separately impregnated

HOW TO SELECT A
WATER
CONDITIONING
SERVICE
With a host of cooling water conditioning "specialists" ready to step in and "solve" your water problems, the job of picking the service best suited for your needs isn't easy. But when you make your selection, consider carefully these three vital factors for successful, economical operation:
• A service based on a sound engineering background
• A service with a proven record
• A service backed by ample engineering facilities
Let's discuss it!
W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa.
BETZ
COOLING WATER CONDITIONING • BOILER WATER CONDITIONING

ONE OF SEVEN

Big Producers

AT KEY WEST, FLORIDA

Seven Layne Well Water Supply units, each testing around 8,000 gallons per minute, have been installed to furnish cooling water for a power project at Key West, Florida. Permanent installations will be Layne Vertical Turbine type Pumps, each having a capacity of 2,300 gallons per minute. Preliminary tests indicate that efficiency will be much higher than promised.

Layne's method of designing, building and installing well water supply units is fully proven in higher production and lower operation cost. All installations are by Layne's own field crews and the work, from start to finish, is under the constant supervision of Layne engineers. Thoroughly tested before final delivery, Layne wells and pumps provide the utmost in dependability and long life.

For late catalogs, bulletins, etc., address

LAYNE & BOWLER, INC.
General Offices, Memphis 8, Tenn.

WELL WATER SYSTEMS FOR CITIES, FACTORIES—

and plants of all kinds. Layne contracts for and builds complete well water supply systems of any size or capacity for cities, factories, ice plants, paper mills, pipe lines, petroleum refineries, air fields, chemical plants, railroads, bottling plants, irrigation farming or for any situation where big quantities of well water must be obtained at extra low cost.

Layne
WATER SUPPLY
WELLS & PUMPS

Send today

for this

FREE

guide to faster, dollar-saving Maintenance Cleaning

THAT handy "OAKITE BOOKLET" above gives you 32 pages of maintenance cleaning procedures successfully solved by Oakite cleaners and methods. Culled from the files of actual cleaning operations, these tested procedures are sure to help you save time and money on many cleaning jobs you come up against in your production, refining, and distribution divisions.

If These Jobs Are on Your Schedule

- **cleaning storage tank interiors**
- **paint-stripping Diesel engines**
- **descaling heat exchange equipment**
- **cleaning bubble towers and absorbers**
- **salvaging valves, piping**
- **cleaning tank cars: inside and out**

Then You Will Want This Book!

Ask your local Oakite Representative TODAY for a free copy of the "Oakite Petroleum Booklet." Or send your request to us at address below. You'll get the lowdown on the way scientific Oakite cleaning lowers operating costs, reduces down-time, gives equipment longer life. Oakite Products, Inc., 50B Thames Street, New York 6, N. Y.

SPECIALIZED INDUSTRIAL CLEANING
OAKITE
MATERIALS • METHODS • SERVICE
Technical Service Representatives in Principal Cities of U.S. & Canada

with the two components. The reaction is carried out at 600-775° F. and hydrogen pressures of 100-400 psi.

U.S.P. 2,563,607. Hydrocarbon Synthesis Promoter. Isidor Kirshenbaum and R. K. Grover to Standard Oil Development Company.

Liquid hydrocarbons are synthesized from CO and H_2 in a ratio of 0.5 to two moles H_2 per mole CO without excessive deposition of carbonaceous material on the catalyst by freeing the synthesis gas of oxygen (to an oxygen content of 0.01-1 percent) and blending from 1-25 percent of acetylene into the feed. The mixture is charged to a dense, fluidized bed of finely divided iron containing catalyst at 550-650° F. Substantial amounts of olefinic hydrocarbon products boiling in the gasoline range are recovered.

DESULFURIZATION

U.S.P. 2,561,990. Method of Desulfurization of Gases. E. B. Miller to Jefferson Lake Sulfur Company.

Details are claimed of a method for the recovery of sulfur from sourgases with the use of a catalyst which is regenerated by removal of the deposited elemental sulfur.

U.S.P. 2,562,767. Sweetening of Petroleum Distillates. J. G. Browder and A. R. Smith to Standard Oil Development Company.

A sour petroleum distillate containing mercaptans boiling below 750° F. is mixed with 0.05-1 gr. per liter (of the distillate) of beta-naphthol and 0.5-2.5 percent by volume of methyl alcohol. The mixture is then contacted with an alkali metal hydroxide solution while adding a mild oxidizing agent to convert the mercaptans to disulfides. A sweetened distillate is obtained.

PETROCHEMICALS

U.S.P. 2,560,610. Production of Alkenylthiophenes. C. R. Wagner to Phillips Petroleum Company.

Thiophene is alkylated with an olefin at a temperature of 400-700° F. in the presence of a silica-alumina catalyst.

U.S.P. 2,561,068. Process for the Preparation of Long-Chain Esters and Nitriles. D. C. Pease to E. I. du Pont de Nemours & Company.

A polymerizable terminally unsaturated olefin with 2-8 C atoms, the two terminal valences of which are bonded to a tertiary carbon of certain aliphatic character is heated with 10-100 percent by weight of an azo compound, the two valences of the -N>N- group being bound to a discrete tertiary C atom of a special further bonding. Dicarboxylic acids and their derivative compounds with a chain of 2-15 C atoms of recurring bivalent units are obtained.

U.S.P. 2,561,787. Production of Nitriles. W. I. Denton and R. B. Bishop to Socony-Vacuum Oil Company, Inc.

An Olefin with up to ten C atoms is reacted with ammonia in vapor phase at a temperature of 850-1075° F. in the presence of nickel phosphate, cobalt chloride or cobalt phosphate. Nitriles with at least two C are formed.

U.S.P. 2,561,995. Acetylene Generation from Hydrocarbons. S. P. Robinson to Phillips Petroleum Company.

Acetylene is produced from preheated low-carbon hydrocarbon material and an amount of separately, but less highly preheated oxygen insufficient for complete combustion of the hydrocarbon. The reactant preheated gases are contacted in a plurality of succeeding reaction zones. Details are claimed.

U.S.P. 2,562,393. Production of Ketonic Boches. Walter Reppe and August Magin.

Ketone compounds such as high molecular polyketo carboxylic acids are prepared by reacting an acetylene with CO and water in the presence of a cyanide of a metal capable of forming metal carbonyls at 60-200° C. and a pressure of about 25 atmosphere.

U.S.P. 2,562,856. Manufacture of Alkyllead Compounds. G. Calingaert and H. Shapiro to Ethyl Corporation.

Hydrocarbon-lead is produced by reacting lead with an arylating or alkylating agent including the hydrocarbon radical in question and having a negative radical which reacts with zinc, and with an alkyl or aryl hydrocarbon-zinc compound.

U.S.P. 2,562,857. Production of Ethylene Oxide by the Catalytic Oxidation of Ethylene. A. Cambron and F. L. W. McKim to The Advisory Council for Scientific and Industrial Research, Ottawa.

Ethylene is reacted with oxygen at a temperature not substantially less than 264° C. in the presence of a catalyst comprising an alloy of silver and 1-15 percent of an alkaline earth metal. At least five percent of the alkaline earth metal of this catalyst is removed to render the alloy catalytically active.

U.S.P. 2,563,050. Treatment of Olefins with Liquid Anhydrous Hydrogen Bromide. Carl B. Linn and Robert J. Newman to Universal Oil Products Company.

Alkyl bromides are produced by reaction of olefins with anhydrous HBr at temperatures below 200° C. and enough pressure to maintain liquid phase. Aromatic hydrocarbons are alkylated with olefins in the presence of anhydrous HBr at these conditions.

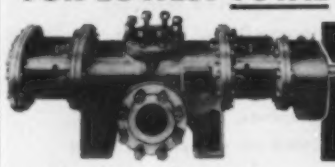
U.S.P. 2,563,073. Haloalkylation of Thiophene. L. Schmerling to Universal Oil Products Company.

A mole excess of a thiophene which contains at least one hydrogen atom bound to its ring is contacted with methallyl chloride in the presence of BF_3 hydrate or a BF_3 ethyl ether complex at a temperature of —20° to 175° C. and a pressure such that substantially all reactants are in the liquid phase. Chlorobutyl thiophenes are produced.

Catalyst Plant Opened

American Cyanamid Company's new $3 million plant in Michigan City, Ind., began production of synthetic cracking catalysts last month. Part of the installation is a spray-dryer, termed the largest of its kind in the world. The dryer forms the catalyst into tiny spheres in much the same way as old shot towers formed molten lead into buckshot.

PUMP ABRASIVE MATERIALS?
FOR LOWEST TOTAL COST, Specify...



Sier-Bath SCREW PUMPS

● Pump shown: new External Gear & Bearing Bracket Type for non-lubricating fluids, semi-fluids. Capacities 1-700 GPM; Discharge 1000 PSI for viscous liquids, 300 PSI for water.

ROTORS INEXPENSIVELY REPLACED

CASINGS INEXPENSIVELY RE-GROUND

Founded 1908 Member A.O.M.A.

Sier-Bath GEAR and PUMP CO., Inc.

BEST BUY FOR PUMPING COAL TAR, ADHESIVES, SOAPS, CRUDE OILS, ETC.

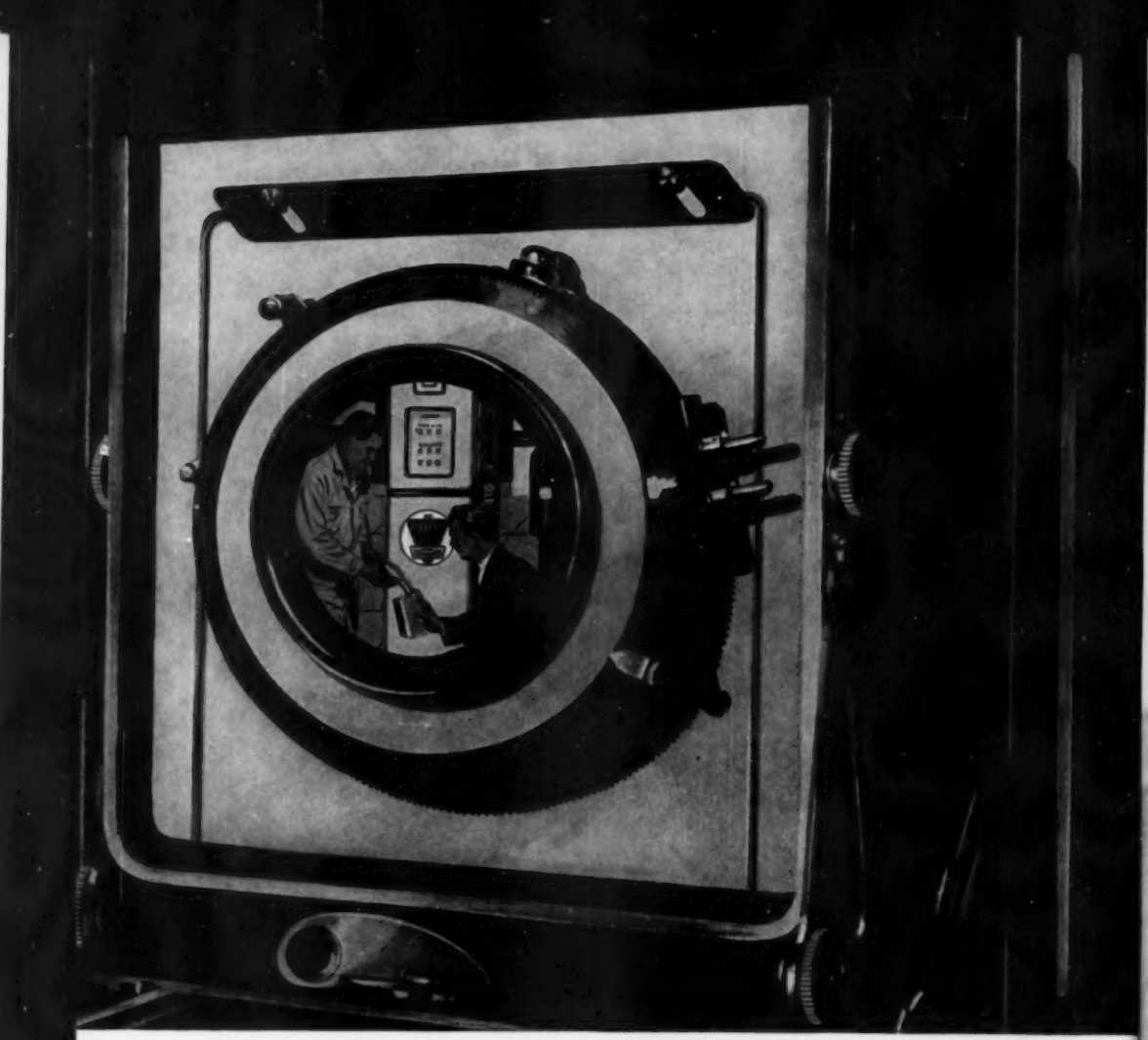
In selecting pumps for abrasive materials applications, be sure to consider *total* cost. Sier-Bath Screw Pumps—though their original cost is higher than gear pumps—in the end cost *less*. The reason: considerably lower maintenance costs. Major over-hauls are simple, inexpensive. They thus enable you to keep your installation running at top efficiency—*without* sky-rocketing your pump costs.

Sier-Bath Screw Pumps are available in horizontal or vertical construction, corrosion resistant alloys. Special bodies, stuffing boxes and bearings for high temperature applications. Sier-Bath "Gearex" Pumps for lower pressures and capacities.

WRITE FOR BULLETIN!

9249 HUDSON BLVD., NORTH BERGEN, N. J.

Also Manufacturers of Sier-Bath Gear Couplings and Precision Gears



14,000 "takes" to give you a clear picture of gasoline trends

It's a lot easier to get a picture of the trend in automobiles than it is to check up on the trends in the fuel that runs them. After all, there are only twenty-odd makes of cars manufactured in the United States, but there are hundreds of oil companies marketing their various brands of gasoline.

In order to furnish you with accurate gasoline-quality information, Ethyl tests more than 14,000 samples a year. These samples are obtained both from refineries and retail pumps throughout the country and furnish the data for national and regional surveys of gasoline quality. Five specially equipped testing laboratories, staffed by experienced technicians, are constantly assembling facts on antiknock value, gum content, distillation and other characteristics.

It's pretty hard to imagine each individual oil company spending the time and effort to do this job for themselves on a

(Continued on next page)

14,000 "takes" to give you a clear picture of gasoline trends

(Continued from preceding page)

national basis. That's why we feel this Ethyl service—which aids all oil companies—is one of the most worth-while we offer.

However, furnishing over-all gasoline quality surveys is only part of the service Ethyl's Gasoline Testing Laboratories offer the petroleum industry. Information on the octane number and lead response of the gasoline and component stocks of individual refiners is furnished them to assist in their work of preparing their own finished gasoline blends.

Our personnel, who are thoroughly skilled in the operation of CFR knock-testing engines, are always available to assist refiners in the maintenance and operation of their own knock-testing equipment. And, naturally, we can be of special help to oil companies who do not have their own testing facilities.

By the way, any time you are in Yonkers, New York; Kansas City, Missouri; Tulsa, Oklahoma; Baton Rouge, Louisiana; or San Bernardino, California, we'd be pleased to have you drop into one of our Gasoline Testing Laboratories to see at first hand all that Ethyl is doing along these lines.

ETHYL CORPORATION

NEW YORK 17, N. Y.

*Experience**

is the most important ingredient in "Ethyl" antiknock fluid

* RESEARCH

* SALES HELPS

* SUPPLY SERVICE

* ROAD TESTING

* TECHNICAL REPORTS

* GASOLINE TESTING

BOOKS of Current Interest

Review and Comment for the Process Man

Biography of Dow

Herbert H. Dow, Pioneer in Creative Chemistry, Murray Campbell and Harrison Hatton, Appleton-Century-Crofts, Inc., New York. $3.50.

This is a biographical sketch of Herbert H. Dow, set down in nontechnical terms and chronological style. It pictures an era when all but a few common chemicals were imported from Europe, and through Dow's problems and deeds, depicts the founding of a chemical manufacture era in the U. S. The two long struggles Dow and other chemists faced during that period of European dominance was the discovery of chemical secrets still guarded zealously by nature; the other was to stay alive in the face of commercially murderous tactics of rich and powerful foreign combines.

Dow's first contribution to the industry was made in 1890 when he invented a new method of extracting bromine from the prehistoric brine trapped underground at Midland, Mich. From that beginning his talents created process after process and product after product. The authors have faithfully chronicled the sequence of events through Dow's lifetime.

Practical Fuel Oil Data

Fuel Oil Manual, Paul F. Schmidt, The Industrial Press, 148 Lafayette Street, New York 13. $3.50.

Written by a chemist experienced in industrial application, Fuel Oil Manual is intended for those who buy, use or sell oil for building heating, power generation, marine applications or industrial processes. It provides a working knowledge of fuel oil and how to use it. Theory and involved discussions of interest only to chemists or refiners are avoided, technical language is used infrequently, and terms are fully explained. A chapter is devoted to each of the various important properties of fuel oil. The author explains the meaning of each property and shows how the information can be applied in selecting, handling or burning fuel oil. The manual provides knowledge of properties and the possibilities and limitations of each grade of fuel oil. It gives the methods which can be used to assure uniform quality and efficient combustion, and other practical matter.

Noxious Wastes

Chemical Wastes, Volume III, API Manual on Disposal of Refinery Wastes, American Petroleum Institute, 50 West 50 Street, New York 20. $1.50.

This edition brings up to date all information which the Committee of Disposal of Refinery Wastes has been able to collect on chemical wastes from refineries. The properties and sources of chemical wastes in refineries is described, the effect of chemical wastes on surface waters, information on methods and devices for treatment and control of wastes and some recommended practices covering equipment and operation of disposal facilities. Extensive lists of references are included. Technical information to assist the refiner in preventing the escape of noxious wastes from the refinery has been in the collecting for the past 20 years; when data is not available the industry has sponsored research to obtain them.

Gas Test Methods

Liquefied Petroleum Gas Specifications and Test Methods, Natural Gasoline Association of America, 422 Kennedy Building, Tulsa 3. $1.

Recommended procedures, approved as of June, 1951, are contained in this latest booklet. Tests cover those for vapor pressure; specific gravity, Pycnometer method; and Hydrometer method; corrosion, copper strip method; total sulfur test, lamp method; propane dryness test, the cobalt bromide method; propane residue test, mercury freeze method; weathering test and sampling of LPG.

Gas Statistics

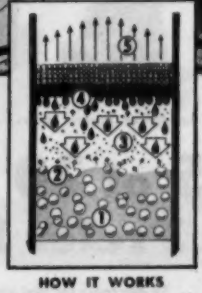
Gas Facts, American Gas Association, Bureau of Statistics, 420 Lex-

From the recovery of liquids entrained in discharge gases to the removal of contaminators to further processing, these simple knitted-wire pads are daily contributing to greater on-grade throughput, increased efficiency and lowered costs in refineries from coast to coast.

Metex Mist Eliminators do just one thing — remove liquids entrained in gases. The diagram shows how they are doing it in stills, towers, cats, knock-outs, evaporators and other vessels.

Efficiencies 95% and better • Little if any pressure drop • Easily installed in existing equipment • Made of practically any metal • No valves or moving parts to service.

Worth looking into, isn't it? For full information, write for free copy of "Metex Mist Eliminators," an 8-page brochure that's packed with facts.



HOW IT WORKS

(1) Gas passes through liquid. (2) Bursting gas bubbles produce fine spray of liquid droplets. (3) Droplets are entrained in rising stream. (4) Droplets coalesce on knitted-wire surfaces to form large drops that fall back against the flow. (5) Gas passes on, freed from entrainment. The liquid is returned.

METAL TEXTILE CORPORATION

KNITTERS OF WIRE MESH FOR MORE THAN A QUARTER CENTURY

633 East First Avenue, Roselle, N. J.

Books

ington Avenue, New York 17. $1.

Composite income statements and balance sheets in dollars for the entire gas utility and pipe line industry for the years 1937 to 1950 inclusive are contained in this new issue of Gas Facts, the annual statistical yearbook of the gas industry.

New records achieved during 1950 and the full extent of these advances is shown in authoritative detail. Data on sales and associated revenues to large-volume customers of utilities and pipe lines are included by type of industry.

Chem Exposition Slated For New York in November

Recent expansion of industries dependent upon chemistry or the application and use of chemical products will be reflected in the twenty-third Exposition of Chemical Industries to be held in Grand Central Palace, New York, November 26 to December 1. It is estimated the chemical process industries will spend $5.5 billion for new plants and equipment this year and $27 billion more for raw materials.

Wage-Hour Regulations Compiled in Digest Form

Employers engaged in interstate commerce will be interested in a booklet of information on the new wage-hour law compiled by the Cincinnati Time Recorder Company of Cincinnati, Ohio. In digest form, the book covers such data as, who must keep records and what records must be kept; defines exempt and non-exempt employes; tells how to compute wages for salaried and hourly workers; lists penalties imposed for non-compliance, and other important facts.

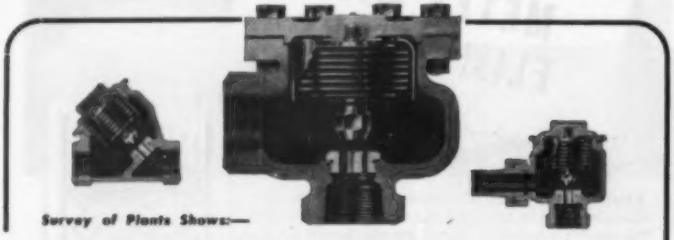
Adams Is Named Safety Director of AGA Group

The American Gas Association has appointed W. H. Adams, Pittsburgh, Pa., as safety consultant for its member companies throughout the country. Adams, a safety director of the Manufacturers Light and Heat Company, and chairman of A.G.A.'s Accident Prevention Committee for the past 18 months, has established his headquarters with AGA in New York.

A native of Fremont, Ohio, Adams has since 1935, served as safety director for utility companies in the Pittsburgh group of the Columbia Gas System which operates in five states.

Diamond Alkali Enlarging Painesville, Ohio, Plant

Extensive enlargement and modernization of present facilities at Diamond Alkali Company's Painesville, Ohio, plant is being planned on a two-year construction basis. The program is designed to step up substantially the output of caustic soda and chlorine by the electrolytic method. The program also includes the installation of a perchlorethylene plant. The utilization of the electrolytic method in producing caustic soda will enable the company to more than double its production of that product.

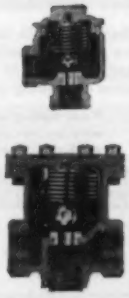


Survey of Plants Shows:—

15 of 20 Engineers Prefer Nicholson Traps

To determine the best steam trap on which to standardize, a large processing firm recently asked their plant engineers for their preference. In 15 out of 20 plants the choice was Nicholson.

The repeated adoption of Nicholson steam traps in plants currently in big "cost-reduction-through-modernization" programs is another indication of their advanced features. To learn why an increasing number of leading plants are standardizing on Nicholson thermostatic steam traps send for our catalog. 5 types for every power, heat, process use; size ¼" to 2"; press. to 225 lbs.



Catalog 751 or see Sweet's

W. H. NICHOLSON & CO. 207 OREGON STREET WILKES - BARRE, PA.

Reprint Policy

For small, individual orders of reprints of its articles PETROLEUM REFINER makes a charge of 50 cents per copy WHEN REPRINTS ARE AVAILABLE.

The charge for tear sheets of a particular article when available is 25 cents.

Cash or company requisitions should accompany all such "individual" orders.

This charge does not affect the price for quantity orders of reprints (starting at 100 orders) which will be quoted upon request. Address Editor, PETROLEUM REFINER, Box 2608, Houston 1, Texas.

Halved Lead Allocations Presage Low Octane Rates

Lead allocations for Ethyl Corporation and Du Pont, two big producers of tetraethyl lead, have been cut "in half" of what these companies estimate to be their monthly requirements based on current consumption. Small gasoline refiners are currently protected by the 1 million pounds of tetraethyl lead allotted any gasoline refiner, but beyond the first million pounds, each refiner is limited to 80 percent of last year's consumption. So far, motor fuel octane ratings in the U. S. have declined only fractionally from last year's levels.

Meanwhile, C. E. Davis, PAD director of refining, predicted that a drastic cut in the anti-knock quality of automobile gasoline for civilian use is threatened unless additional supplies of metallic lead are made available for manufacturing tetraethyl lead. He warned that a 47 percent reduction in the amount of tetraethyl lead available to refiners may be necessary and could mean an across-the-board cut of three points in the average octane rating of motor gasoline across the nation.

SoVac Health Program Names Research Specialist

In a move toward greater protection of employes' health, the Socony-Vacuum Oil Company, Inc., has designated a research specialist for advanced study of industrial hygiene. Selected for a year's post-graduate work at Harvard University School of Public Health is Arthur C. Pabst, assistant supervisor of processes and products research at the technical service department, Brooklyn. After obtaining an M.S. degree in industrial hygiene, Pabst will join the staff of Dr. G. M. Saunders, So-Vac medical director, at New York headquarters.

Pabst is a chemical engineering graduate of Brooklyn Polytechnic Institute.

Defense Technicians Get Course in Instrumentation

A group of 58 technicians and scientists engaged in the engineering, design and application of process and research instruments vital to national defense last month completed a special two-weeks course of instruction by Minneapolis-Honeywell Regulator Company in Philadelphia.

The group included representatives of government, the military and private in-

dustry who are working on atomic energy and related projects.

Studies included lectures and visual instruction in function plotting, area monitoring and neutron detection, also in electronic recording, indicating and controlling instruments, pneumatic controls and systems, flow calculations and measurements and similar instrument applications for liquid levels, pressures and other process variables.

Hugh Hamilton to Direct A. V. Smith Engineering

A. V. Smith Engineering Company, corrosion consultants, have appointed Hugh L. Hamilton to manage and direct company activities from their offices in Bala-Cynwyd, Pa. For the past 15 years Hamilton was associated with the Atlantic Refining Company subsidiaries, the Keystone Pipe Line Company and Buffalo Pipe Line Corporation. A professional enginer in Pennsylvania, Hamilton was responsible for the pipe lines corrosion control program, and also acted in an advisory capacity to the various Atlantic Refining Company departments and subsidiaries.

Hamilton

Petro-Chem Industry Shows Significant Gains

Petroleum production has risen from $350 million to $2 billion per annum and will reach $7 billion volume within another ten years according to Dr. W. E. Kuhn of The Texas Company. He told the National Petroleum Association that petro-chemicals may be the most important industrial development of many decades. At present more than 25 percent of all chemicals being made are produced from petroleum. By 1962 he predicted that 50 percent of chemicals produced would be of petroleum derivation.

One major petroleum chemical, ethylene glycol, is produced for anti-freeze at the rate of 500 million pounds a year. A growing trend is developing to manufacture acrylo-nitrile from acetylene rather than ethylene glycol. Other growing phases within the petrochemical industry are detergent, plastic, wrapping film and insulation manufacture.

Refinery Waste Disposal Volume Is Now Available

The second edition of Volume III, Chemical Wastes, an API Manual on Disposal of Refinery Wastes, is off the press and available for $1.50 per copy through the American Petroleum Institute, 50 West 50 Street, New York 20. Latest information collected by the committee on Disposal is incorporated into the 40 page booklet.

Caltex Names Enkemeier

Arthur R. Enkemeier has been appointed assistant treasurer of the California Texas Oil Company. Prior to his employment by Caltex, Enkemeier was with the Irving Trust Company for 18 years.

AIChE Technical Session October 19 in Galveston

Technical sessions that are programmed to interest executives, chemical engineers and students alike are planned for the sixth annual technical meeting of the South Texas section of the American Institute of Chemical Engineers when it meets at the Hotel Galvez in Galveston on October 19.

Catalytic reforming will be discussed by Jack C. Dart, Houdry Process Corporation, Marcus Hook, Pa. Henry G. McGrath of M. W. Kellogg Company, N. J., will talk on Fluid Hydroforming. "Developments in the Field of Petrochemicals" is the subject of a session headed by Fred W. Sullivan, Jr., consultant of Madison, N. J.

R. N. Giles, Standard Oil Company (Indiana), Chicago, will speak on "A Rational Approach to Industrial Waste Disposal Problems." Two members of the U. S. Geological Survey at Austin, Texas, will speak on "Potential Fresh Water Supply on the Gulf Coast."

A good attendance of AIChE members is anticipated.

49 Oil Firms Cited for Modernized Annual Reports

Forty-nine of five thousand entering petroleum companies have qualified for "Highest Merit" citations for Annual Reports upon the basis of ratings awarded by Weston Smith of Financial World for the Eleventh Annual Survey. One of the 49 qualified stockholder reports will be awarded the "Best of Industry" title and presented with a bronze

• Outside packed—without stopping unit. Dependable, trouble-free operation in V-belt or geared drives. Send for details.

Richard L. Conway

The Patterson Foundry and Machine Company
East Liverpool, Ohio, U. S. A.
NEW YORK, BOSTON, BALTIMORE, PHILADELPHIA, PITTSBURGH, DETROIT, CINCINNATI, CHICAGO, ST. LOUIS, HOUSTON, DENVER, LOS ANGELES, SAN FRANCISCO, SEATTLE
The Patterson Foundry and Machine Company, (Canada) Limited
Toronto, Canada
MONTREAL

"Oscar of Industry" at the Financial World Annual Report Awards Banquet on Monday, October 29. The 1949 annual report of Standard Oil Company (New Jersey) won the award trophy for the best report in this industrial classification.

Those companies whose reports qualified for the trophy are: Ashland Oil Refining, British-American Oil, Atlantic Refining Company, Cities Service Company, Continental Oil Company, Creole Petroleum Corporation, Deep Rock Oil, Delhi Oil Company, Derby Oil Company, Douglas Oil of California.

Frontier Refining Company, Gulf Oil Corporation, Houston Oil, Texas, Humble Oil & Refining, Imperial Oil, Ltd., International Petroleum, Kendall Refining, Lion Oil Company, McColl-Frontenac Oil, Mid-Continent Petroleum, Mid-West Refineries, Ohio Oil Company, Pacific Western Oil.

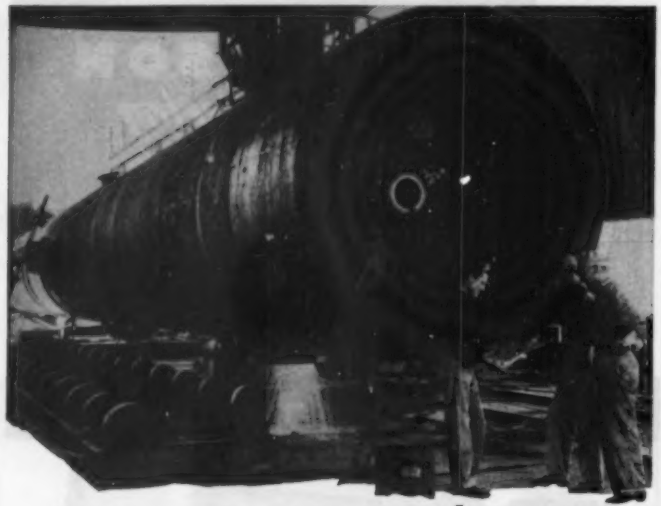
Pan American Petroleum & Transport, Pancoastal Oil, Petroleum Heat & processing, Phillips Petroleum Company, Plymouth Oil Company, Pure Oil Company, Roosevelt Oil & Refining, Quaker State Oil Refining, Richfield Oil Corporation, Shamrock Oil & Gas.

Shell Oil Company, Sinclair Oil Corporation, Socony-Vacuum Oil Company, South Penn Oil Company, Standard Oil of California, Standard Oil (Indiana), Standard Oil (N. J.), Standard Oil (Ohio), Sun Oil Company, Sunray Oil Corporation, Texas Company, Texas Pacific Coal, Tidewater Associated, Union Oil of California, Warren Petroleum, Woodley Petroleum.

Chemicals Wanted

The National Registry of Rare Chemicals, Armour Research Foundation, 33rd, Federal and Dearborn Streets, Chicago 16, has received urgent requests for the chemicals listed below. If anyone has one or more, even if only one gram quantities, please inform the Registry.

1,3-Dichloro-2-methylbutane
Dicyclohexyl disulfide
(Dichlorofluoromethyl)benzene
1,6-Dimercaptohexane
1,1-Dimethylallylmercaptan
Dioctyl thioether
4,4'-Diphenyldiphenyl
1-Methyl-3,6-dihydroxycyclohexane
3-Methylquinoline
Sodium-n-hexadecyl sulfate
Tetrahydrothiapyran
1,2,3-Triaminopropane
para-Vinyldiphenyl
1,4-Pentadiene
Trinaphthylmethane
N-Methylthiobutyramide
Pentanethiol-3
Butanedithiol-2,3
2,2-Difluoroheptane



McNamar can solve all of your

fabrication PROBLEMS

When you have vessel fabrication problems — turn them over to McNamar. Refinery and gasoline plant vessel fabrication is our specialty. Our complete facilities and experienced personnel are ready to serve you — let us know about your requirements.

McNamar Boiler & Tank Co.

REFINERY SALES DIVISION • BOX 868, TULSA, OKLAHOMA

Publisher's Statement

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, AND JULY 2, 1946 OF PETROLEUM REFINER, published monthly at Houston, Texas, for October 1, 1951.

State of Texas, County of Harris, ss:

Before me, a Notary Public in and for the State and county aforesaid, personally appeared A. L. Burns, who, having been duly sworn according to law, deposes and says that he is the Business Manager of PETROLEUM REFINER and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily, weekly, semiweekly or triweekly newspaper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the act of August 24, 1912, as amended by the acts of March 3, 1933, and July 2, 1946 (section 537, Postal Laws and Regulations), printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Ray L. Dudley, 3:71 Chevy Chase, Houston, Texas; Editor, William L. Bolles, 768 West 42nd St., Houston, Texas; Managing Editor, Silas B. Ragsdale, 1636 North Blvd., Houston, Texas; Business Manager, A. L. Burns, No. 7 Chelsea Place, Houston, Texas.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.)

The Gulf Publishing Company, Houston, Texas; James Anderson, Houston, Texas; June Wooden Bliss, Houston, Texas; June Wooden Dudley Bliss, Trustee for Miss Fredrica Lucinda Dudley, Houston, Texas; A. L. Burns, Houston, Texas; James F. Carter, Jr. (Deceased), Tulsa, Oklahoma; Margaret D. Cashman, Houston, Texas; Carolyn Dodson Dudley, San Angelo, Texas; P. Stinson Dudley, Hebbronville, Texas; Ray L. Dudley, Houston, Texas; Wm. G. Dudley, Freeport, Texas; Libbie Rice Farish, Houston, Texas; Wm. V. Gross, Utopia, Texas; Mrs. Anita S. Lane, Houston, Texas; Charles H. Lane, Houston, Texas; James William Nelson, Baytown, Texas; Tom W. Nelson, Houston, Texas; J. Kent Ridler (Deceased), Houston, Texas; Walter Gage Sterling, Trustee for Mrs. Maud G. Sterling, Houston, Texas; O. R. Walter, Chicago, Illinois; Patricia McFarland Windham, Austin, Texas.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities are: M. D. Anderson Foundation, Houston, Texas.

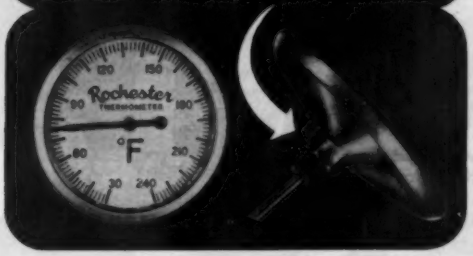
4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

A. L. BURNS, Business Manager.

Sworn to and subscribed before me this 9th day of August, 1951.

P. J. AUCOIN,
(Seal) Notary Public in and for Harris County, Texas.
(My commission expires June 1, 1953.)

RECALIBRATE *on the job—*
Rochester
DIAL THERMOMETERS



Accidents are bound to happen . . . like dropping or banging a thermometer sufficiently hard to make readings inaccurate. This could result in costly production errors. To eliminate this possibility, Rochester now offers a new bi-metallic Dial Thermometer with screw adjustment permitting recalibration on the job! Simply put the instrument in boiling water or other known temperature and reset indicator. Better order today. Send for Catalog No. IT-650, Rochester Manufacturing Co., Inc., 38 Rockwood St., Rochester 10, N. Y.

ROCHESTER
MANUFACTURING COMPANY, INC.
DIAL THERMOMETERS GAUGES AMMETERS

VOLUMETRIC AND PHASE BEHAVIOR OF HYDROCARBONS

by

BRUCE H. SAGE and WILLIAM N. LACEY

This standard reference work, reporting investigations of the authors closely related with Research Project 37 of the American Petroleum Institute, first published in 1939 and out-of-print for some two years, is again available.

The author's announced purpose for the volume, "to set out for consideration the fundamental principles and some of the facts relating to that type of hydrocarbon behavior which does not involve chemical reactions or changes in the molecular species present," indicates rather accurately the principal contents.

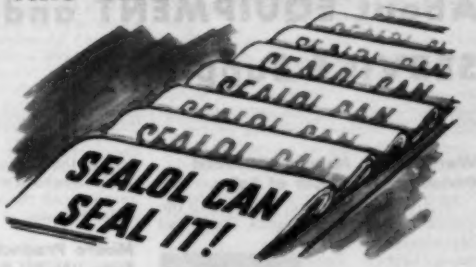
Chapter headings of the book include: Introduction; Mathematical Concepts; Behavior of Pure Substances; Two-Component Systems; Three Component Systems; Multi-Component Systems; The Phase Rule; Partial Quantities; and Ideal Solutions.

Over 300 pages *5½" x 8½"* *Price $5.00*

"Prices subject to change without notice"

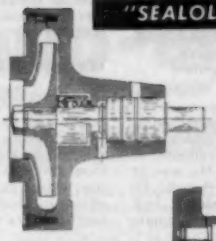
BOOK DEPARTMENT
THE GULF PUBLISHING COMPANY
P. O. Box 2608
HOUSTON 1, TEXAS

THIS NEWS TRAVELS FAST!

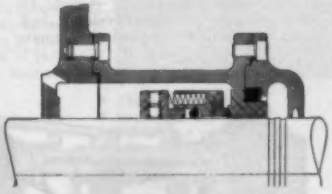


Where there's the WILL, "Sealol" is the WAY to get better sealing of rotary shafts. This balanced pressure mechanical shaft seal has proven itself in countless applications, handling the widest range of fluids, temperatures, pressures, and shaft speeds.

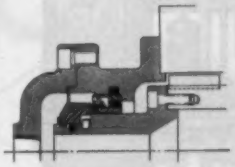
HERE ARE A FEW RECENT "SEALOL" APPLICATIONS:



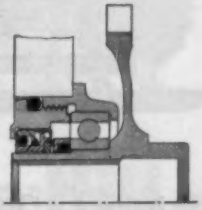
"SEALOL"
FCB Water Pump Seal (water 55 PSI, 3400RPM)



"SEALOL"
Chemical Pump Seal (dye liquor 20 PSI, 1750 RPM)



"SEALOL"
Seal for Fluid Transfer (cutting oil 700 PSI, 3000 RPM)



"SEALOL"
Seal for Power Take-Off . . . Gas Turbine Engine (oil mist 5 PSI, 6000 RPM)

If you have a sealing problem, chances are "SEALOL" CAN SEAL IT! Write for engineering recommendations. Sealol Corporation, 45 Willard Ave., Providence 5, R. I.

SEALOL
Chicago • Cleveland • Detroit • Los Angeles • New York • San Francisco

About EQUIPMENT and SERVICE Suppliers

Worthington Names Mumford Divisional Manager of Sales

W. Clifford Mumford, assistant to the manager of the Worthington Pump and Machinery Corporation's Vertical Turbine Pump Sales Division, was appointed manager of the division to succeed the late Frank Kemp. A Worthington employe since 1938, Mumford advanced successively from positions in the Holyoke (Mass.), Works machine shops and erection department to his present position.

Mumford

He will be assisted by Fenmore E. Dunn, formerly consulting sales engineer. Dunn has been with Worthington since June, 1950, and is a graduate of the University of Cincinnati. He was at one time chief engineer of the A. D. Cooke Company of Lawrenceburg, Ind.

Both men will make their headquarters at the Harrison, N. J., sales offices J. W. Hepburn will continue as assistant manager of the vertical Turbine Pump Sales Division at the Denver Works.

Moore Products Gives London Firm "Null"-Balance License

Moore Products Company has licensed Sunvic Controls, Ltd., London, to manufacture Moore Industrial instruments in England. The British company, a subsidiary of Metropolitan-Vickers Electrical Company, Ltd., is a prominent manufacturer of scientific and industrial instruments. They will manufacture the Moore pneumatic "null"-balance type instruments in their Harlow plant.

Wolverine Color Film Released

"The Tube of Tomorrow," a 25 minute, 16 mm color film, has just been completed for distribution upon request by the Wolverine Tube Division of Calumet and Hecla Consolidated Copper Company. It discusses the modern manufacturing processes employed by Wolverine in producing seamless, non-ferrous tubing in its new plant in Decatur, Ala.

Solvay Sales Division Names Three to Executive Office

The Solvay Sales Division of Allied Chemical & Dye Corporation has made the following executive appointments: Lester B. Gordon, vice president; Denman Peniston, director of Sales; John H. Elleman, assistant director of sales.

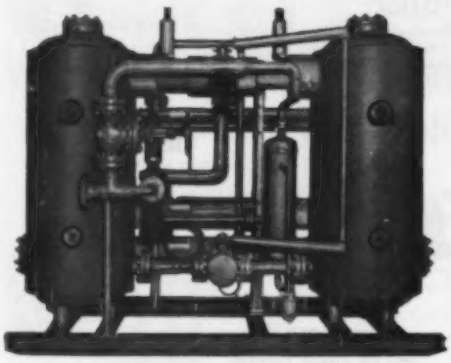
Gordon

Peniston

Elleman

Gordon, a veteran of 36 years continuous service with The Solvay Sales Division and its predecessor companies, is a native of Chicago but resides in New Jersey at the present time.

Peniston, a native of New Jersey, began work as an office boy for the Solvay Sales Division predecessor 41 years ago and subsequently was named salesman,



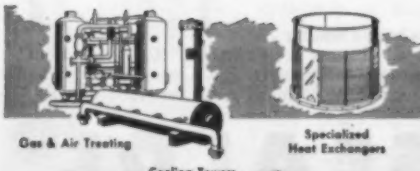
UNEXCELLED—
FOR DEPENDABLE
DEHYDRATION!

The Pritchard HYDRYER*

The Pritchard HYDRYER* is *unexcelled* for dependable dehydration of air and other gases for instrument and process controls. Dual adsorbers provide continuous drying action. Standard packaged units designed to reduce dew points to minus (—) 40°F. Only service connections are required. Specially designed HYDRYER* units can be tailored to your individual requirements.

*Registered Trade Name

Write Today for Bulletin No. 16.0.080



Products of QUALITY Specialized Process EQUIPMENT

J.F. Pritchard & Co.

EQUIPMENT DIVISION

Dept. No. 147 — 908 Grand Ave., Kansas City 6, Mo.

District Offices: CHICAGO • HOUSTON • NEW YORK • PITTSBURGH
TULSA • ST. LOUIS • Representatives in Principal Cities from Coast to Coast

manager, and assistant director of sales within the organization.

Elleman is a graduate of West Point and served many years in the Corps of Engineers before resigning with the rank of Colonel to enter the heavy construction field. He worked with the Indiana State Highway Department before joining the Solvay organization. At present he resides in Connecticut.

Wendland Heads Service Office At Elliott's Pennsylvania Unit

A. P. Wendland has been appointed manager of the general service department of the Elliott Company, with headquarters at Jeannette, Pa. Wendland succeeds the late Frank Murphy who had been Elliott service manager since the department was organized in 1918.

Wendland

Wendland joined Elliott Company in 1925, having been graduated in mechanical engineering from Oregon State College. He was assigned as a field engineer to the Philadelphia office after completing his apprentice course. For a year, 1942-43, he served as assistant to the Director of Research and Development in Jeannette, In 1943 he established the Wilmington, Del., district office, and for the past year had been manager of Mechanical Sales of the Philadelphia office.

Worthington Retains Retiring VP as West Coast Consultant

Charles Ebem Wilson, sales vice president of Worthington Pump and Machinery Corporation, retired recently but was retained by the company as a West Coast Consultant on sales problems. He will also continue to act on the board of directors of Wintroath Pumps, Inc. In 1946 when Wilson was elected president of the Worthington-Gamon Meter Corporation in addition to his executive sales duties he became the third "Charles Wilson" to be a corporation president. The other two head the General Motors and General Electric corporations. A Worthington veteran of 59 years, Wilson joined the company as an office boy and worked up to the executive position.

Wilson

Altorfer Appointed Engineer For Nordstrom Valve Division

Hans A. Altorfer has been appointed chief engineer for Nordstrom Valve Division of Rockwell Manufacturing Company at Oakland, Calif. Altorfer is a graduate of Winterthur Institute of Technology in Switzerland and has had 20 years experience in mechanical engineering, theory, and design practice. He is a registered professional engineer in Wisconsin and a member of various professional societies.

Honeywell Appoints Five to Administrative Capacities

Charles C. Buckland has been elected a vice president of Minneapolis-Honeywell Regulator Company in a series of personnel changes announced recently.

Buckland, who is also a director and secretary of the company, will head a newly created sub-contracting division which will correlate and expand subcontracting activities of the aeronautical and ordnance defense programs.

A Yale graduate, Buckland joined Honeywell in 1931 after serving as general manager of the Berkshire Street Railway, and has been secretary of M-H since 1932 and a director since 1937.

Glenn Seidel, who has been assistant to the vice president in charge of engineering, has been appointed to the newly-created post of director of ordnance. Another new post, superintendent of ordnance, will be filled by Stanley J. Nelson, superintendent of manufacturing.

Other appointments resulting from the growth of the company's Aeronautical division and the increasing importance of Honeywell's activities in the ordnance field include: E. H. Salzman, formerly assistant director of the division, to director of aeronautical administration. M. P. Fedders, formerly works manager of M-H, to manager of aeronautical operations. Howard J. Stoops, formerly manager of administration, to director of manufacturing.

Honeywell, which during the last war became one of the nation's leading volume producers of ordnance fire control

BH
therm-enomics*
presents
MONO-BLOCK
The Black Rockwool Insulation
Baldwin-Hill's Mono-Block features these outstanding properties in answer to your problems of industrial heat control:
• Effective to 1700°F
• Lower cost installed
• Folded layer construction
• Light, resilient
• Cuts easily
• Low alkalinity factor
• Resistant to moisture and high humidity
IF IT'S TOO HOT TO TOUCH
IT NEEDS INSULATION
If you have a problem of heat loss, consult Baldwin-Hill on the best type of insulation to use—and how to use it. THERM-ENOMICS* service is backed by a complete line of Black Rockwool insulating materials . . . block, blanket, cements, etc.
*Economics of Engineered Heat Control.
Baldwin-Hill
Black Rockwool
clip this coupon and attach to your signed letterhead
SEND ME COMPLETE INFORMATION ON:
☐ Mono-Block—for temperatures to 1700°F
☐ Blankets—metal reinforced, large-area coverage to 1200°F
☐ No. 1 Cement—plastic insulation, to 1800°F
☐ Powerhouse Cement—high-adhesion finishing to 1700°F
8231
BALDWIN-HILL CO., 781 BREUNIG AVE., TRENTON, N. J.

PYREX BRAND **sight glasses are most dependable**

To see what you're doing, always insist upon Pyrex brand sight glasses!

Here is a glass that is compounded to give you high resistance to acids and thermal shock plus complete visibility over long periods.

Whatever you operate—ovens, furnaces, stills, evaporators, reactors, pressure kettles, etc.—you need the EXTRA VALUE that is afforded by Pyrex brand Sight Glasses. Available through your Industrial Supply Distributor.

CORNING GLASS WORKS

CORNING, N. Y.

T.M. REG. PYREX U.S. PAT. OFF.

Gauge Glasses, Sight Glasses, Oil Cup and Lubricator Cup Glassware.

+ 100 Years of Making Glass Better and More Useful +

equipment, has expanded its fire control and precision aircraft controls manufacture to handle government defense contracts. The expansion involves not only enlarged facilities, but increased research, engineering and production activities.

M-H's new $2.8 million Aeronautical Engineering building was opened formally last month and work is now nearing completion on 100,000 additional square feet of production facilities, a substantial part of which will be devoted to the production of autopilots and gyros.

Downey Heads New Swartwout District Office at Houston

The Swartwout Company of Cleveland, manufacturer of power plant, proc-

Sharp

Downey

ess control and ventilating equipment, have appointed J. B. Downey, sales engineer, to manage the power plant and process control divisions of a new sales office opened recently in Houston. Downey, a graduate of Case Institute of Technology, was formerly with National Carbon Division of Union Carbide and Carbon Corporation, and with General Dry Batteries, Inc., both of Cleveland.

William A. Sharp, Houston, will be in charge of roof ventilator sales engineering and service for the new Houston office. He is a University of Illinois graduate and has served as sales engineer in the southern and central U. S. for several companies, the most recent being the Fluor Corporation of Los Angeles.

Continental Supply Promotes Six Supervisory Personnel

Six members of The Continental Supply Company personnel have been promoted: Waif Strain, warehouseman and pump repairman at Lindsay, Okla, was transferred to Russell, Kan., as store manager. N. K. Keller, manager at Kermit, Texas, was transferred to Snyder in the same capacity. Conley H. Sims, manager at Monahans, Texas, has been transferred to Kermit, Texas, in the same capacity. Roy A. Henley, floorman at Monahans, Texas, was promoted to store manager. Tommy B. McClelland, assistant store manager at Eunice, La., was promoted to store manager. J. I. McQuiddy, salesman at Kilgore, Texas, was transferred to the Casper, Wyo., district office as manager of production equipment sales.

American Meter Names Holtz Manager New Dallas Meter Plant

American Meter Company of Philadelphia, manufacturers of precision measurement equipment for the gas and oil industries, appointed Donald C. Holtz of Erie to manage the newly opened

See the difference

A. O. SMITH SAFETY GRATING

Full 100% serration of all bearing bars and cross bars insures 360° non-slip protection . . . in any weather . . . under all conditions.

More Apex Safety Grating, made by A. O. Smith Corporation, is used on America's railroads than all other makes combined. For 15 years A. O. Smith *locked-for-life* grating construction has provided the ultimate in strength and reliability in this, the severest service of all.

Now this time-proved safety grating is available for industrial applications. You owe it to the safety of your employees to specify this outstanding safety grating.

Let A. O. Smith put your plant on a safe footing.

Stair Treads . . . and plain surface grating . . . where maximum non-skid protection is not essential . . . are also available.

A.O.Smith

Safety Grating and Stair Treads

District Offices: Chicago 4 • Dallas 2 Houston 2 • Los Angeles 22 • New York 17 Pittsburgh 19 • Tulsa 3

A FEW TERRITORIES STILL OPEN TO DISTRIBUTORS

A. O. Smith Corporation Grating Division, Dept. PR-1051 Milwaukee 1, Wisconsin

Without obligation send me complete information on your Safety Grating.

Name _____

Firm _____

Address _____

City _____ Zone ____ State _____

☐ I am interested in a Distributorship.

REFINING BOOKS OF THE PETROLEUM INDUSTRY

To Earn More - Learn More

The knowledge gained through years of work and study by some of the most capable men in the oil industry is set down in the books listed below. Because it is impossible to carry in one's head all the details of his industry, a well-rounded library of reliable data is a definite asset. Not only does it save time, but it often makes his available knowledge of a subject more accurate and up-to-date.

Order some of these books and profit by the experience of others.

ABRAHAM, HERBERT
Asphalts and Allied Substances (2 Vols.) $25.00

ADAMS, ORVILLE
Elements of Diesel Engineering 5.00

ARMISTEAD, GEORGE, JR.
Safety in Petroleum Refining and Related Industries ... 10.00

BADGER & MCCABE
Elements of Chemical Engineering 6.00

BELL, H. S.
American Petroleum Refining 7.50

BENNETT, H.
Chemical Formulary—Vol. 1 thru 9 (each) 7.00
Chemical and Technical Dictionary 10.00

BERKMAN & EGLOFF
Emulsions & Foams 12.00

DIEHL, JOHN C.
Natural Gas Handbook—cloth 7.15
Natural Gas Handbook—leather 8.50

ECKMAN, DONALD P.
Principles of Industrial Process Control 3.75

EGLOFF, GUSTAV
Physical Constants of Hydrocarbons
Vol. 1 ..... 8.50
Vol. 2 ..... 10.00
Vol. 3 ..... 13.00
Vol. 4 ..... 14.50

ELLIS, CARLETON
Chemistry of Petroleum Derivatives
Vol. 1 ..... 20.00
Vol. 2 ..... 22.50
Chemistry of Synthetic Resins 25.00

FIESER & FIESER
Organic Chemistry 10.00

GILL, THOMAS T.
Air and Gas Compression 3.50
Compression and Natural Gas Alignment Charts 4.50

GRAHAM, FRANK D.
Pumps, Hydraulic and Air Compressors 4.00

GRISWOLD, JOHN
Fuels, Combustion & Furnaces 6.00

HESSE & RUSHTON
Process Equipment Design 8.00

KALICHEVSKY & STAGNER
Chemical Refining of Petroleum 8.25

KINGSTON, BENSON M.
Acidizing Handbook 2.50

KIRKBRIDE, C. G.
Equilibrium Evaluation Charts 5.00
(20 charts to set)

KIRSCHBAUM, DR. EMIL
Distillation and Rectification 10.00

LEDOUX, EDWARD
Vapor Adsorption 8.50

LOHSE, HENRY WM.
Catalytic Chemistry 8.50

MCADAMS, WM. H.
Heat Transmission 5.50

MANTELL, C. L.
Adsorption 9.00

NELSON, W. L.
Petroleum Refinery Engineering 9.00

ROBINSON, C. S
Recovery of Vapors 4.00

ROBINSON & GILLILAND
Elements of Fractional Distillation 7.00

SACHANEN, A. N.
Conversion of Petroleum 12.00

SAGE & LACEY
Volumetric and Phase Behavior of Hydrocarbons 5.00

SCOTT, WILFRED W.
Standard Methods of Chemical Analysis (2 Vols.) 22.00

SHERWOOD, THOS. K.
Absorption & Extraction 4.00

SPELLER, FRANK K.
Corrosion: Causes & Prevention 8.00

STANIAR, WILLIAM
Plant Engineering Handbook 15.00

THOMAS, CHARLES A.
Anhydrous Aluminum Chloride in Organic Chemistry .. 16.50

TREYBAL, ROBERT E.
Liquid Extraction 7.50

TYLER, CHAPLIN
Chemical Engineering Economics 4.00

WALKER, LEWIS, MCADAMS & GILLILAND
Principles of Chemical Engineering 6.50

"Prices subject to change without notice"

Send Orders to

THE GULF PUBLISHING COMPANY

P. O. Box 2608 **HOUSTON, TEXAS**

WIRE MESH

Maybe it all *does* look pretty much the same at first glance. But when a firm has been making wire mesh for 70 years man and boy, there's bound to be a little more to it than meets the eye—a little more know-how in engineering and weaving, a little more quality in the product, a little more service and satisfaction for the user.

JELLIFF WIRE MESH is woven in all ductile metals
JELLIFF WIRE MESH is woven in all commercial weaves
JELLIFF WIRE MESH is woven in widths up to 72 inches
JELLIFF WIRE MESH is economical. Every foot runs true to the specifications.

★ ★ ★ ★

JELLIFF WIRE MESH is a quality product and has been for 70 years. You can depend on it.

Write today for full details about JELLIFF WIRE MESH, JELLIFF WIRE MESH PRODUCTS, and JELLIFF'S CONSULTATION SERVICE on wire-mesh engineering. Address Department 16.

THE C. O. JELLIFF MFG. CORP.
DIPPING BASKETS · LEKTROMESH · RESISTANCE WIRE
WIRE MESH PARTS · WIRE CLOTH · STRAINERS · FILTERS
SOUTHPORT CONNECTICUT
WIRE PRODUCTS SINCE 1870

4 WAYS TO CUT THOSE PUMP REPAIRS

Sims valves are made in sizes from 2¾" to 15¼" to fit any reciprocating pump. Valves supplied ready to install—cast in individual units or in complete plates.

1. **Prevent STEM and SPRING breakage.** Exclusive double shock absorber built into Sims valves stops impact shock.
2. **Stop wear.** Long guide of ROTATOR prevents cocking of DISC—assures even opening.
3. **Keep seating surfaces leak free.** Only Sims guarantees the valve DISC will rotate every time it lifts.
4. **Stop valve slam and knock.** Quiet operation is gained by cushioning moving parts and cutting resistance to flow through the SEAT... with patented **inclined ribs.** This reduction of resistance allows cylinders to fill completely. Pump capacity is increased 20%.

SIMS PUMP VALVE CO., INC.

New catalog shows how Sims valves fit any pump—how they work—efficiency and comparison charts. Send for your free copy today.

145 HUDSON ST., NEW YORK 13, N. Y. • M & M BLDG., HOUSTON, TEXAS

orifice meter plant with display rooms at Dallas. Equipment related to orifice meters, such as orifice plates, flanges, needle valves, fittings and gage line connections will also be produced. Instrument schools for special groups will be conducted by the company's instrument experts.

Kitzmiller Assumes Post as Rockwell West Coast Head

H. Boezinger, West Coast sales manager of Rockwell Manufacturing Company has appointed Robert B. Kitzmiller manager of the San Francisco office. Kitzmiller replaced Gilbert T. Bowman, who was recently transferred to Rockwell headquarters in Pittsburgh as sales manager of gas products.

Kitzmiller

Kitzmiller joined Rockwell in 1934 and worked in the Production and Sales Order departments of the main office in Pittsburgh. In 1940 he was made Assistant to the Director of Sales, a position he held until 1945 when he was transferred to the Los Angeles office. Shortly thereafter he was assigned to the Seattle territory as a sales engineer.

Stabler Named Head of New Du Pont Personnel Division

W. Laird Stabler has been named manager of Du Pont's newly created Organization Planning Division. The new division is a unit within Du Pont's Employee Relations Department, and was created to provide a training program which will assure the company well-trained personnel to fill future managerial openings.

Stabler will be succeeded as manager of the Personnel and Industrial Relations Division of the Rayon Department, by William R. Creadick. Creadick has been employed in the Rayon Department for 15 of the 36 years he has been with Du Pont.

One of the pioneers of nylon manufacturing operations, Stabler joined Du Pont 25 years ago as foreman at the Old Hickory, Tenn., rayon plant. He is a graduate of Princeton University.

Snyder, Jr.- Elected Chief Executive of Blaw-Knox Company

W. Cordes Snyder, Jr., of Sewickley, Pa., has been elected president and chief executive officer of Blaw-Knox Company and will assume his new duties about November 1. Snyder previously was a vice president in charge of the Lewis Foundry & Machine Division, and more recently served as vice president of the Koppers Company and manager of its Metallurgical Department. A mining engineer graduate of Lehigh University, he is a member of many professional societies.

William P. Witherow, formerly president and chairman of Blaw-Knox, will continue as chairman of the board of directors. Chester H. Lehman will continue in his present capacities of vice chairman of the board and executive vice president.

FIRST EXAMINE...
THEN SELECT
THE GRATING
WITH ALL
5
SUPERIOR FEATURES!

1. STRONG electro-forged construction for easy installation.

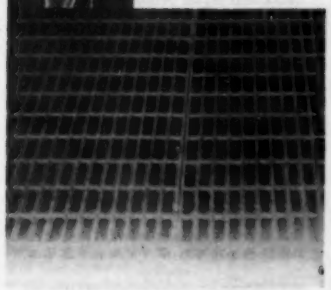
2. MAXIMUM OPEN AREA for light and air.

3. EASY TO MAINTAIN...paint reaches entire surface.

4. SELF-CLEANING, no sharp corners to clog.

5. SAFE footing at all times with twisted cross bar.

Write for complete specifications



BLAW-KNOX DIVISION
OF BLAW-KNOX COMPANY
2005 Farmers Bank Building
Pittsburgh 22, Pa.

BLAW-KNOX
Electroforged STEEL
GRATING AND STAIR TREADS

A. O. Smith Appoints Treen Manager Personnel-Purchasing

A. O. Smith Corporation has appointed Alfred E. Treen to succeed F. B. Dunn,

Treen

Madden

retired, as manager of personnel and purchasing at the Houston Works. Also promoted was John B. Madden who was named hydraulic sales manager for the North Central district with affices in Chicago.

Treen, a member of the company since 1946, has participated in forming and administering the company's over-all personnel policies. Previously he worked in personnel, safety and industrial relations work for the U. S. Steel Corporation.

Madden, a former product supervisor, originally operated hydraulic sales from the Houston Works where vertical turbine pumps are manufactured.

Baldwill-Hill Appoints Mohun Manager of Insulation Sales

J. L. Mohun has been appointed division manager of Industrial Insulation Sales for the Baldwin-Hill Company. He will be located at the new sales office established by Baldwin-Hill at 4101 San Jacinto Street, Houston.

Mohun

The appointment of Mohun, in conjunction with the recent purchase by the Baldwin-Hill Company of the Tex-Rock Insulation Manufacturing Company of Temple, Texas, will enable the company to serve the Southwest more effectively. The Baldwin-Hill Company has offices located at New York, Trenton, N. J., Chicago, Jackson, Mich., and Los Angeles.

Babcock & Wilcox Moves Eastern Sales Office to Downtown Address

The local district sales headquarters of The Babcock & Wilcox Tube Company, formerly established at the plant, has moved to new facilities in the business section of Beaver Falls, Pa. Located at 712 Eleventh Street, the office occupies a complete building leased and remodeled by the Tube Company and convenient to railroads, other public transportation and the local hotel. The office maintains a sub office in Cleveland and has a sales representative in Toronto, Ontario, Canada. James A. Cook is district sales manager with headquarters in Beaver Falls.

anti-corrosive
strapping and seals

Send for free booklet and Strap Calculator containing information as to suitable type of metal to be used.

Describes A. J. Gerrard special strapping and tools.

FREE
Handy calculator—one side tells you which strap to use for any given corrosive condition; the other side determines length and weight of strap required for any binding operation. Sent

Gerrard & Co.
1936 Hawthorne Ct., Mahwah Park, Ill.
(Chicago Suburb)

Whiton SOLID STEEL ROTOR
STEAM
TURBINES

WHITON
LABYRINTH
SHAFT SEAL . . .
SINCE 1911

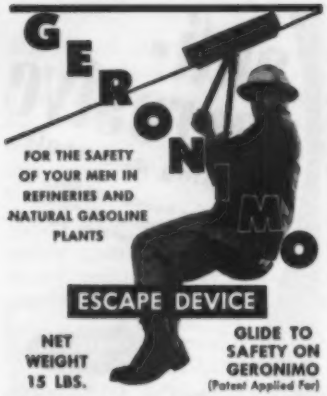
Whiton Turbines in service 25 years without seal replacement

Because:

- Factory run-in assures perfect seal and minimum wear.
- Labyrinth seals do not contact shaft, eliminating wear and seizing.
- Steam ejector feature positively prevents steam leakage at outer end of shaft seal.

Write for complete details.

Whiton SINCE 1856
WHITON
MACHINE COMPANY
New London 14, Conn., U.S.A.


GERONIMO
FOR THE SAFETY OF YOUR MEN IN REFINERIES AND NATURAL GASOLINE PLANTS
ESCAPE DEVICE
NET WEIGHT 15 LBS.
GLIDE TO SAFETY ON GERONIMO
(Patent Applied For)

GERONIMO will stand hardest wear and give unfailing protection to refinery and derrick men whose lives are endangered by fire, escaping gases or other hazards.

EASILY ATTACHED OR REMOVED
EXTRA STURDY CONSTRUCTION
QUICKLY STRADDLED
POSITIVE, INSTANT BRAKE
BRONZE "No-Spark" SURFACES
RECOMMENDED FOR ½" WIRE LINE

• Write for Illustrated Folder •

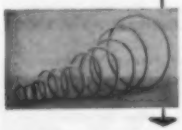
— MANUFACTURED BY —
CHARLIE'S MACHINE WORKS
PERRY, OKLAHOMA

CHICAGO-WILCOX GASKETS
Proved in Service in the Refinery Industry

GASKETS FOR HEAT EXCHANGERS, COOLERS AND CONDENSERS

Gaskets cut from solid metal, sheet-packing, or double jacket type as needed.

Corrugated metal gaskets for refinery use. Made of ingot iron, Terne-plate, aluminum, stainless steel and monel in sizes from 1 inch up.



A.P.I. ring gaskets for high pressure lines for use on ring-type flanged joints. Made of soft iron and all standard steel alloys in oval and octagonal shapes.

See page 252 in the Refinery Catalog.

CHICAGO-WILCOX Mfg. Co.
7703 Avalon Avenue
Chicago 19, Illinois

De Laval Completes Service Offices for West Coast Area

De Laval Steam Turbine Company of Trenton, N. J., has completed a new building at 160 Folsom Street, San Francisco, Calif. This building will be De Laval's new San Francisco hearquarters for sales and service activities. Besides providing increased warehousing facilities for standard centrifugal pumps, IMO pumps, speed reducers and flexible couplings it will also permit much faster handling of repair and service orders for De Laval's western customers.

This expanded West Coast activity will continue under the direction of C. F. Reeves.

Clark Bros. Names Probst Manager Western Regional Sales

Clark Bros. Company, Inc., have appointed George W. Probst to the position of western regional sales manager. Probst has been associated with the sales department of Clark for the past 30 years. For the past ten years he has been the district sales manager of the Tulsa district. In his new position, Probst will coordinate the sales efforts of the California, Oklahoma, Texas and Chicago territories. His headquarters will remain in the Clark Bros. Company sales office at 125 West First Street, Tulsa, Okla.

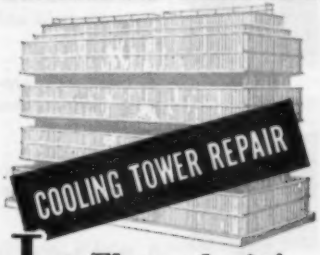
Probst

Klingerit, Inc., Changes Name To Strahman Valves, Inc.

Herman Strahman, president of the renamed Klingerit, Inc., explained that the name of the Klingerit organization was changed to Strahman Valves, Inc., to avoid confusion with high pressure packing manufactured by Richard Klinger, Ltd., of England. The Strahman Valve company is U. S. representative for the London firm but also manufactures valves and level gauges. The change involves no change of ownership, management or policies, according to Strahman.

Dowell Promotes Groom to Sales Development Division

Claude H. Groom, development engineer in the industrial division, was promoted to assistant sales development manager of Dowell Incorporated. Groom has been associated with Dowell and its parent organization, The Dow Chemical Company, since 1936 when he joined The Dow Chemical Company staff at the organic research laboratories in Midland, Mich. In 1939 Groom was assigned to the group experimenting with maintenance cleaning of industrial equipment. He was sent to Tulsa in 1945 as technical advisor on industrial problems.



Let Fluor do it!

Whether your cooling tower is new or old—natural or mechanical draft—let a qualified Fluor Service Representative study your maintenance and repair problems—at no cost to you!

2 Free Services Available

1. **Preventative Maintenance**—Fluor will recommend a preventative maintenance program based on operating conditions and locale—and then arrange for periodic inspections!

2. **Estimates for Repair**—Fluor will inspect to determine repairs necessary to bring your tower back to original design efficiency—then bid for the job competitively!

Inquire through any Fluor Office

THE FLUOR CORPORATION, LTD.
2500 SOUTH ATLANTIC BLVD., LOS ANGELES 22, CALIF.
offices in
NEW YORK • CHICAGO • TULSA • HOUSTON • SAN FRANCISCO

EXCEL-SO
COALESCERS
remove all free water from products streams prior to dessicant dehydration.
Send For Descriptive Bulletin
WARNER LEWIS COMPANY
P. O. BOX 3096-D • TULSA, OKLA.

James Kneubuhl Heads New York Sales District for Fluor

James P. Kneubuhl, assistant manager of sales for the Fluor Corporation, Ltd., Los Angeles engineering and construction firm, has assumed the responsibility of district sales manager of the New York office in addition to his present duties. Kneubuhl joined the firm in 1941 as an assistant project engineer. He held the position of advertising manager from 1944 to 1946 when he was transferred to the sales department. A graduate of Stanford University, he has taken post graduate work at the University of Southern California.

Kneubuhl

American Cyanamid Elects New Executive Personnel

Several American Cyanamid Company executives were elected to new posts recently. E. D. Powers, vice president in charge of production, was elected to the board of directors to succeed H. P. Eastman who retired last month.

A. J. Campbell, general manager of the Industrial Chemicals Division, and Howard Huston, formerly assistant to the president, were elected vice presidents. L. C. Duncan was elected assistant to the president.

J. J. Murray and G. C. Walker were named assistant treasurers, and J. W. King and W. B. Ward were named assistant comptrollers.

Midwest Piping & Supply Names Brock Research Director

John E. Brock, who was recently named director of research for the Midwest Piping & Supply Company, Inc., will make his headquarters at the main plant and executive office in St. Louis. Brock investigated the mechanical properties of plastic ceramic bodies for the Westinghouse Research Laboratories and spent two years with the Union Electric Company of Missouri as a technical engineer. An associate professor of applied mechanics and mathematics at Purdue, Minnesota and Washington universities, Brock holds an M.S. degree in engineering from Purdue, and a Ph.D. from the University of Minnesota.

Brock

Flexitallic Adds Six Agents In Continental Expansion

Flexitallic Gasket Company, Camden, N. J., has added six new agents and one new distributor to its field organization. The new agents include:

Jno. D. Hiles Company, Inc., Pittsburgh, for western Pennsylvania and eastern Ohio and portions of West Virginia; Engineering Products Company, Charleston, W. Va., for West Virginia, eastern Kentucky, and part of Ohio; Chapman Engineering Sales Company, Cincinnati for southwestern Ohio and northern Kentucky.

Also De Haven Engineering Company, Indianapolis, for Indiana and western Kentucky; Steel & Engineering Products Company, El Paso, Texas, for southwestern Texas, southern New Mexico and Arizona; Energy Control Corporation, Philadelphia, for eastern Pennsylvania, southern New Jersey and Delaware.

Fleck Bros., Ltd., Vancouver, B. C., is a new Flexitallic distributor and will serve the western provinces of Canada.

G. Frederic Bauer, Expert On Flame Photography, Dies

G. Frederic Bauer of Elkins Park, Pa., chief technologist of the National Airoil Burner Company of Philadelphia, died in California last month while on a business trip. Bauer, employed by National Airoil Burner Company for 19 years, specialized in oil and gas problems for the glass, ceramic and steel industries, and worked extensively with oil combustion work for stationary and marine boiler plants. He was a pioneer and an expert on high temperature flame photography and the flow of gases in petroleum furnaces.

Gale Carroll Joins Houston Sales for Taylor Forge & Pipe

Gale Carroll has been added to the Houston district sales office of Taylor Forge & Pipe Works. Carroll, a resident of Texas for the past 15 years, formerly served as sales and advertising manager for Tube-Kote, Inc. A graduate of Hastings College and the University of Nebraska, he is a member of the NACE and the API.

Haydite Manufacturer Opens Home Sales Office in Dallas

Home offices of Texas Industries, Inc., successor to Texas Lightweight Aggregate Company and supplier of much of the Haydite aggregate used in refractory concrete, have been established in the First National Bank Building in Dallas. Products of twelve subsidiary companies are used throughout the offices. It has been reported that Haydite is used for refractory concrete in virtually every refinery and chemical plant in the world.

PETROLEUM

REFINER CLASSIFIED ADS

RATES for Classified Ads are $1 per column inch. Minimum size one column inch. In smallest type size, figure 50 words per inch. Situations Wanted $4 per column inch. All classified ads payable in advance. Ten percent discount if three or more insertions are ordered at same time. COPY DEADLINE is 25th of month preceding date of issue. Send copy and checks to: Classified Ad Department, Petroleum Refiner, P. O. Box 2608, Houston 1, Texas.

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

FOR SALE

DEPROPANIZER

Taken Out of Service and Replaced With Larger Vessel August, 1951

SPECIFICATIONS

FABRICATOR: WYATT

DESIGN:
API-ASME CODE, 369 psi W.P., 400° F, 554 psi Test, 462 psi Hammer Test Pressure

DIMENSIONS:
30" x 48' 0" plus 1' 0' Skirt, .500" Shell, .500" F & D Heads, ESTIMATED WEIGHT 12,-354#

TRAYS:
30 on 16" Spacing, Bubble Type, 13 - 4 x 4 x 3 Caps per tray, 2" OD risers, side type downcomer

LOCATION:
Plant site near Bishop, Texas

CONDITION:
Excellent

PRICE:
$4,500.00 where is, as is, subject to prior sale

Southern Minerals Corporation
P. O. Box 716
Corpus Christi, Texas

HELP WANTED

Mechanical Engineer who has had actual supervisory experience in refinery of machine shop, pump, engine and turbine repair. Southwest refinery. Box 101-R, Petroleum Refiner, Houston, Texas.

Process Engineer who has had at least five years refinery experience. Southwest refinery. Box 102-R, Petroleum Refiner, Houston, Texas.

WANTED: Petroleum Chemist or Treating Engineer with two to four years' experience in gasoline treating for technical service with large Chemical Company selling to the Petroleum Industry. Position involves considerable traveling in East and Middlewest. Please include details of education and professional experience, as well as a recent photograph, in first letter. Box 105-R, % Petroleum Refiner, Houston, Texas.

KAYLO
INDUSTRIAL INSULATION
SALES ENGINEER

We require the addition of a capable, qualified, interested sales engineer in our Kaylo Products Division, who is free to relocate. Experience in high temperature applications essential. Age 25-45. Engineering background required. Salary commensurate with ability.

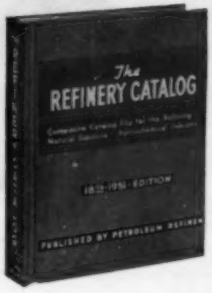
Write full particulars to J. A. Sweeny, Director, Selection of Specialized Personnel, Owens-Illinois Glass Co., P. O. Box 1035, Toledo 1, Ohio.

ADVERTISERS

in the October, 1951, issue of

Petroleum Refiner

*** The asterisk preceding name of advertiser indicates that detailed data on products and services of the firm will be found in The 1951 Refinery Catalog.**



A

*Aerofin Corp. 216
*The Air Preheater Corp. 2
*Airetool Manufacturing Co. 210
Alan Wood Steel Co. 208
*Aluminum Company of America 57, 211
*American Brass Co. 83
*American Locomotive Co. 27
American Meter Co. 75
American Steel & Wire Co. 101
The Annin Co. 47
*Armstrong Machine Works 5

B

*The Babcock & Wilcox Co. 68-69, 92
*Badger Process Division
Stone & Webster Engr. Corp. 44-45
*Baldwin-Hill Co. 231
*Beaver Pipe Tools, Inc. 240
W. H. & L. D. Betz 222
Big Three Welding Equipment Co. 240
*Black, Sivalls & Bryson, Inc. 185
*Blaw-Knox Co. 20, 182, 235
*Bridgeport Brass Co. 91
The Bristol Co. 18
*The Brown Fintube Co. 204
*Byron Jackson Co. 9

C

Calumet & Hecla Consolidated Copper Co. 10
*Cameron Iron Works, Inc. 176
The Chapman Valve Manufacturing Co. 55
Charlie's Machine Works 236
Chase Brass & Copper Co. 79
*Chemical Construction Corp. 62
Chicago Bridge & Iron Co. 64
*Chicago-Wilcox Mfg. Co. 236
*Clark Bros. Co. 76-77
The Clark Manufacturing Co. 170
Classified Advertising 237
Coast Paint & Lacquer Co. 210
Columbia Steel Co. 191
*The Continental Supply Co. ..... Insert 64
*The Cooper-Bessemer Corp. 167
*Corning Glass Works 232
*Crane Co. 56
*Croll-Reynolds Co. 221

D

The Davison Chemical Corp. 88
*Dean Brothers Pumps Inc. 206
Dempster Brothers, Inc. 58
*Dollinger Corp. 21
Dowell Incorporated 66
*Dresser Industries, Inc. 76, 173
E. I. du Pont
de Nemours & Co. ..... 70, Insert 160-161
Duranametallic Corp. 190

E

*The Eagle-Picher Co. 34-35
Earl Paint Corp. 85
Electric Steel Foundry 171
*Elliott Co. 50, 163
*Engineers & Fabricators, Inc. 40
Enjay Co. 65
Ethyl Corp. ..... Insert 224-225

F

*Fisher Governor Co. 54
*Flint Steel Corp. 214
*The Fluor Corp. 236
*Foster Wheeler Corp. ..... Insert 32-33
The Foxboro Co. 202

G

*The Garlock Packing Co. 31
*General Electric Co. 12-13, 160-161
A. J. Gerrard & Co. 235
*Gilbert & Barker Manufacturing Co. 59
*The Girdler Corp. 11
A. P. Green Fire Brick Co. 63
*Grinnell Co. 19
*The Gulf Publishing Co. 215, 229, 233, 240

H

Hudson Engineering Corp. 87

I

*Industrial Division
Minneapolis-Honeywell Regulator Co. 36-37
*Ingersoll-Rand Co. 30
*International Engineering, Inc. 174
The International Nickel Co. 7, 99

J

*The C. O. Jelliff Mfg. Co. 234
*Johns-Manville 16, 104

K

*Keasbey & Mattison Co. 32
*The M. W. Kellogg Co. ..... Insert 96-97
Kerotest Manufacturing Co. 26
*The Koch Engineering Co. 169

L

Layne & Bowler, Inc. 223
Leeds & Northrup Co. 8
Warner Lewis Co. 236
*The Lummus Co. 198

M

Manning, Maxwell & Moore, Inc. 200
*The Marley Co. 103
*Mason-Neilan Regulator Co. 213
The Master Electric Co. 6
*A. Y. McDonald Mfg. Co. ..... IV Cover
*Arthur G. McKee & Co. 165
McNamar Boiler & Tank Co. 228
*Metal Textile Corp. 225
*Minneapolis-Honeywell Regulator Co. 36-37
*Mixing Equipment Co. 194
Monsanto Chemical Co. 51
*Mundet Cork Corp. 212
*Murray Iron Works Co. 180

N

The Nalmco Co. 220
*National Airoil Burner Co. 221
*National Carbon Co. 180
National Lead Co. 200
National Tube Co. 191
*W. H. Nicholson & Co. 226

O

*Oakite Products, Inc. 223
*The Ohio Steel Foundry Co. 186
Oil Well Supply Co. 89
*Orbit Valve Co. 179

P

*Pabco Products, Inc. 188
Page Steel & Wire Division
American Chain & Cable Co. 177
*The Patterson Foundry & Machine Co. 227
*Petro-Chem Development Co. 60
*Petroleum Rectifying Co. 39
Philadelphia Gear Works, Inc. 175
Pittsburgh Lectrodryer Corp. 207
The Wm. Powell Co. 14
*The Pressed Steel Co. 15
*J. F. Pritchard & Co. 217, 230
Procon, Incorporated 24-25
Pyrene Manufacturing Co. 178

R

Reading-Pratt & Cady Division
American Chain & Cable Co. 187
*Republic Steel Corp. 22, 172
*Revere Copper & Brass, Inc. 239
*The Ridge Tool Co. 184
*Rochester Manufacturing Co. 229
*Rockwell Manufacturing Co. 28-29
*Rockwood Sprinkler Co. 61
*Roots-Connersville Blower Corp. 173

S

*Scovill Manufacturing Co. 17
Sealol Corp. 229
Shand & Jurs Co. ..... Insert 65
Shell Chemical Corp. 48-49
Shell Development Co. 218
Sier-Bath Gear & Pump Co. 224
Sims Pump Valve Co. 234
A. O. Smith Corp. 232
*Stone & Webster Engineering Corp. 44-45
*Struthers Wells Corp. 43
*Sun Shipbuilding & Dry Dock Co. 42
Superior Manufacturing Co. 240

T

*Taylor Forge & Pipe Works 23
Tennessee Coal, Iron & Railroad Co. 191
*The Terry Steam Turbine Co. 38
The Timken Roller Bearing Co. 4

U

*Union Asbestos & Rubber Co. 52
*Union Carbide and Carbon Corp. 180
United States Steel Co. 191
United States Steel Corp. 80, 191
United States Steel Export Co. 191
United States Steel Supply Co. 191

V

The Vapor Recovery Systems Co. 196
*Henry Vogt Machine Co. 46
Vulcan Copper & Supply Co. 72

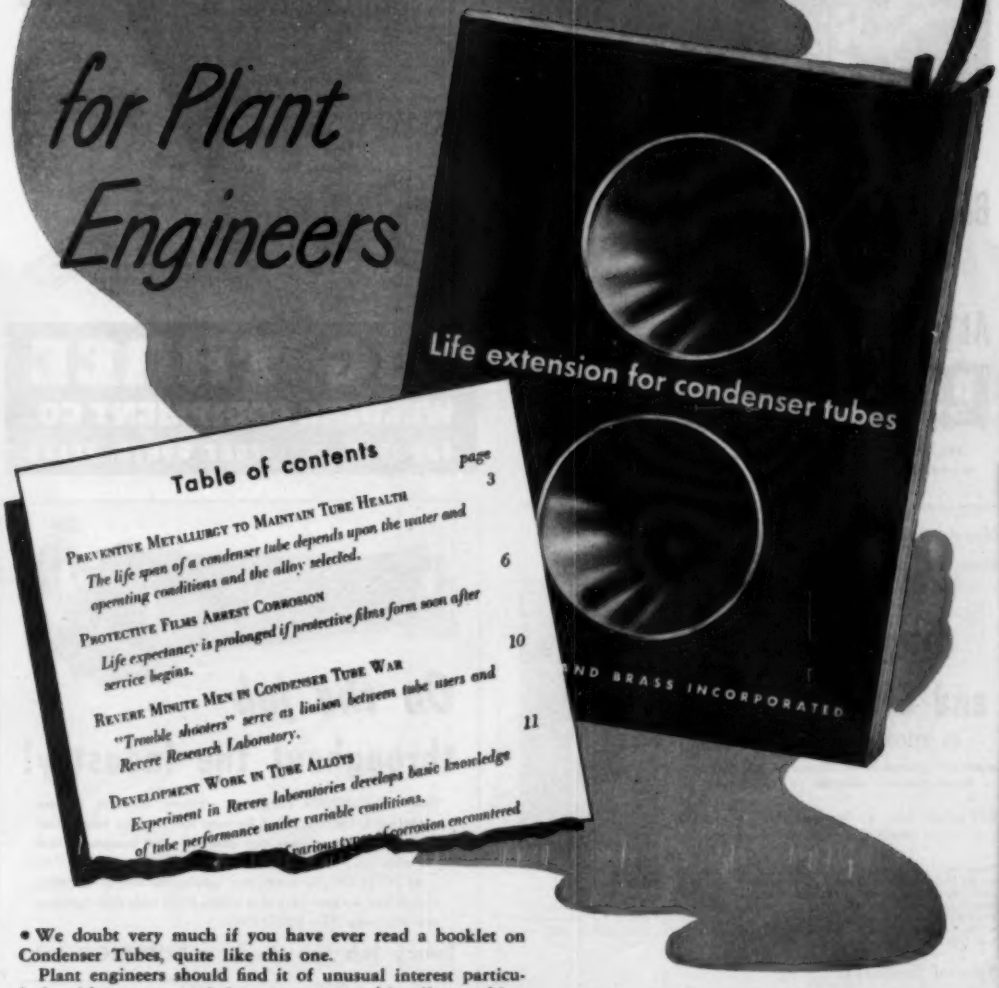
W

*Wallace & Tiernan Products, Inc. 183
Walworth Co. 53
Warren Petroleum Corp. ..... I Cover
*Western Supply Co. 33
Whiton Machine Co. 235
Wolverine Tube Division, Calumet &
Hecla Consolidated Copper Co. 10
*Worthington Pump & Machinery Corp. 41
Wyatt Metal & Boiler Works ..... III Cover

Y

*Yarnall-Waring Co. ..... II Cover
Young Radiator Co. 3

"MUST" Reading for Plant Engineers


Life extension for condenser tubes
Table of contents
page
PREVENTIVE METALLURGY TO MAINTAIN TUBE HEALTH
The life span of a condenser tube depends upon the water and operating conditions and the alloy selected. 3
PROTECTIVE FILMS ARREST CORROSION
Life expectancy is prolonged if protective films form soon after service begins. 6
REVERE MINUTE MEN IN CONDENSER TUBE WAR
"Trouble shooters" serve as liaison between tube users and Revere Research Laboratory. 10
DEVELOPMENT WORK IN TUBE ALLOYS
Experiment in Revere laboratories develops basic knowledge of tube performance under variable conditions. 11
various types of corrosion encountered
ND BRASS INCORPORATED

• We doubt very much if you have ever read a booklet on Condenser Tubes, quite like this one.

Plant engineers should find it of unusual interest particularly with present restrictions on copper and its alloys making it more important than ever that every last ounce of use be squeezed out of the condenser tubes in their plants.

This 28-page booklet includes data on various copper alloys, photos of cut-away tube sections showing various types of corrosion encountered in condenser tube service and photomicrographs showing the grain structure of different kinds of metals under varying operating conditions.

Send for your copy today. Please make request on your firm's letterhead. Thank you. Address Department P.R., Revere Copper and Brass Incorporated, 230 Park Avenue, N. Y. 17, N. Y.

REVERE 150 Years of Progress in America

COPPER AND BRASS INCORPORATED

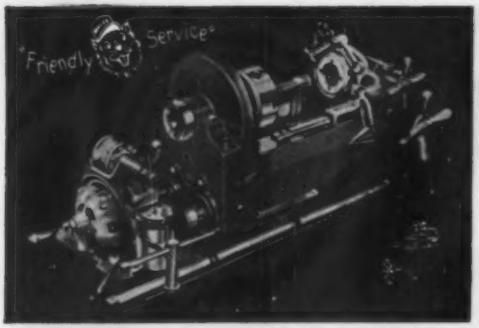
Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N. Y.

• •

Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.— Sales Offices in Principal Cities, Distributors Everywhere.

SEE "MEET THE PRESS" ON NBC TELEVISION EVERY SUNDAY



the BEAVER MODEL-A is ALWAYS NEWS!

BEAVER PIPE TOOLS

252-300 DANA AVE.
WARREN, OHIO, U. S. A.

Performance is what counts in a pipe machine . . . and, successful performance is always news . . . year after year.

Beaver Model-A Pipe and Bolt machine gives you quick, clean threads, precision cutting and reaming. It is right handed with all controls in front. You get 50% greater working space, gear driven power in abundance, and a full range from ⅛ to 2 inches.

Reversible Universal motor, safety "shear pin," rack and pinion feed, self-centering wheel and roller cut-off, heavy duty chuck, adjustable opening die heads, interchangeable die segments and an easily accessible oil pump . . . all add up to top performance.

For more information on successful pipe tool operation . . . write for catalog on the BEAVER line today.

Tempilstiks°

The amazing CRAYONS that tell temperatures

For heat-dependent operations, control temperatures with TEMPILSTIKS°. Simplicity, accuracy, and economy have made them standard equipment in thousands of industrial plants. Available for 56 different temperatures from 113° to 2000°F—one for every temperature commonly specified for ***welding, flame cutting, tempering, forging, casting, molding, drawing, straightening,*** and scores of other heating operations. Eliminate guesswork. Order today.

$2 each gives up to 2000 readings

ALSO AVAILABLE IN LIQUID OR PELLETS

it's this ***SIMPLE***

1. Select Tempilstik° for working temperature you want.
2. Mark your workpiece with it.
3. When mark melts, specified temperature has been reached.

BIG THREE WELDING EQUIPMENT CO.

BOX 1538 FORT WORTH, TEXAS

Here's help in the design and operation of absorption and extraction equipment.

ABSORPTION and EXTRACTION

By THOMAS K. SHERWOOD

Associate Professor of Chemical Engineering, Massachusetts Institute of Technology

278 pages — 91 illustrations — $4.00

"Prices subject to change without notice"

This book outlines the underlying theory of such important diffusional processes of the unit operations of chemical engineering as absorption, extraction, drying, humidification, and dehumidification. Particular attention is given to the engineering problems connected with the design and operation of equipment for absorption and extraction.

Special Features:

—chapters on absorption of multi-component mixtures and on solvent extraction.
—treatment of equilibria in liquid-vapor systems of mixed hydrocarbons.
—method of calculation used in the design of absorbers for natural gasoline and refinery gases.
—outline of the general procedure and treatment of petroleum problems.

SEND CHECK TO

GULF PUBLISHING COMPANY

P. O. BOX 2608 HOUSTON 1, TEXAS

On the job throughout the industry!

You find SUPERIOR equipment wherever efficient, modern operation is needed. Why? Because the industry knows that we manufacture refinery and gasoline plant equipment that operates under the toughest conditions.

At SUPERIOR your plans, too, receive the careful attention and skilled workmanship that meets strict code and customer specifications. TRY SUPERIOR!

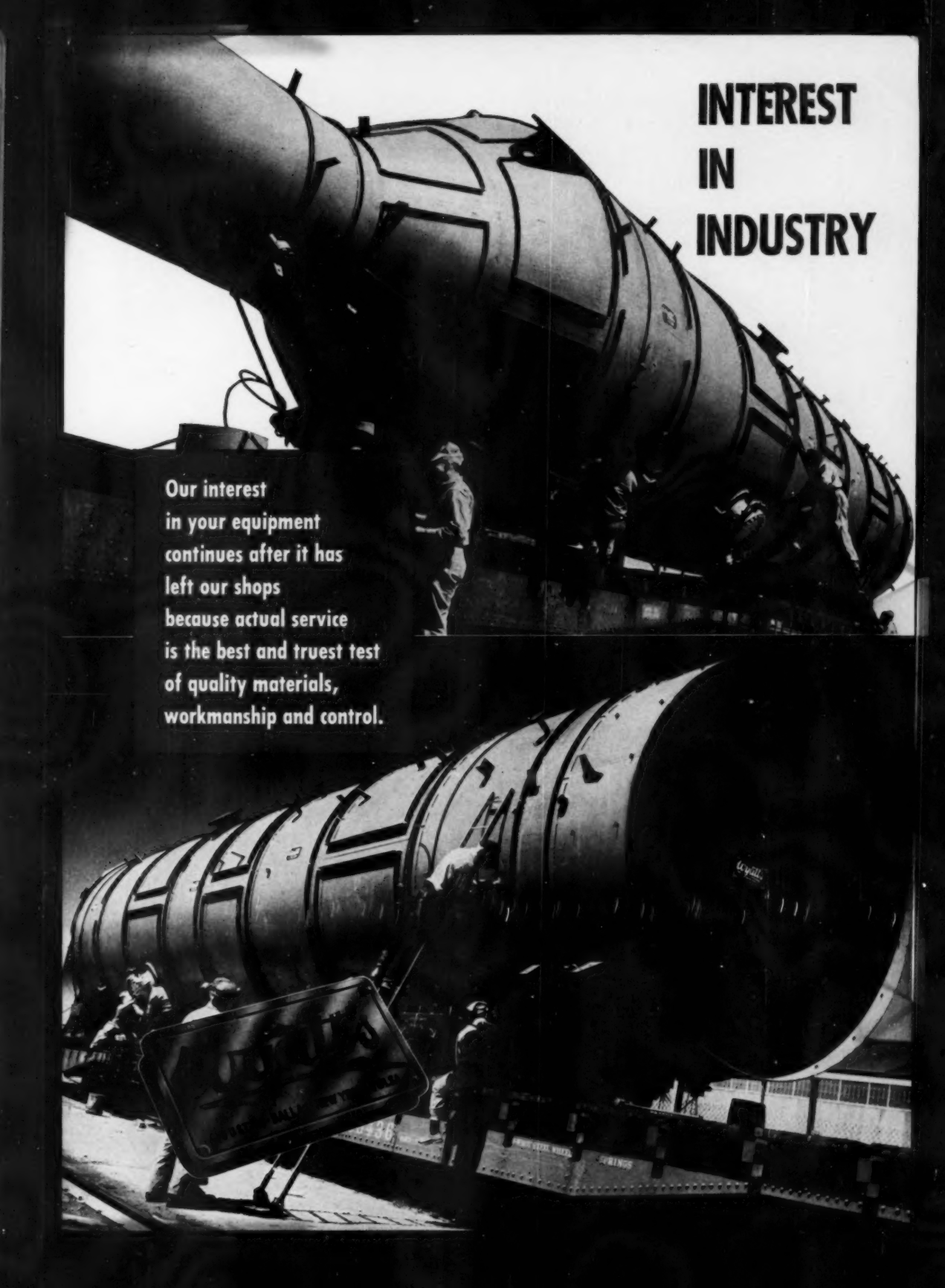
Every job we do is a SUPERIOR job!

ALSO
FRACTIONATING TOWERS • HEAT EXCHANGERS • SCRUBBERS AND RETUBING OF HEAT EXCHANGERS

API-ASME AND ASME CODE
CERTIFIED BY NATIONAL BOARD

For information or estimates call Amarillo 3-4395

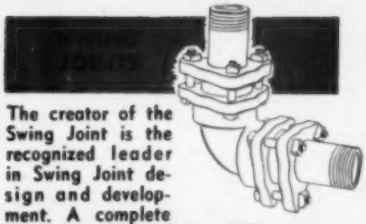
SUPERIOR MANUFACTURING COMPANY
AMARILLO, TEXAS


INTEREST
IN
INDUSTRY
Our interest
in your equipment
continues after it has
left our shops
because actual service
is the best and truest test
of quality materials,
workmanship and control.

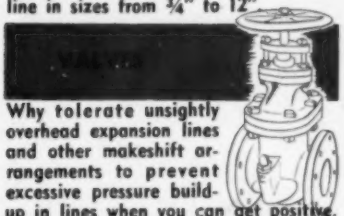
EST. 1856
McDonald

Your Logical FIRST Choice for Oil Handling Equipment

BACKED BY 95 YEARS OF MANUFACTURING EXPERIENCE



The creator of the Swing Joint is the recognized leader in Swing Joint design and development. A complete line in sizes from ¾" to 12".



Why tolerate unsightly overhead expansion lines and other makeshift arrangements to prevent excessive pressure build-up in lines when you can get positive, automatic protection with the McDonald 4" Expansion Relief Gate Valve?

Balanced design, special features, introduce a new standard of loading efficiency. The development of years of special study of loading problems.

For nearly 100 years the McDonald reputation has rested on a solid foundation of completely reliable products—products that combine the latest in engineering with an extra measure of sturdiness that means a generous bonus of service. Where else can you get such positive assurance of the results you look for in oil handling equipment?

A. Y. McDONALD MFG. CO.

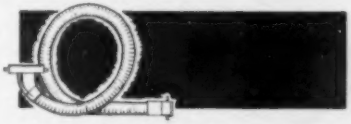
The Home of the Swing Joint

DUBUQUE, IOWA

There's a McDonald Branch or Distributor Near You

Used when loading high-test gasoline—reduces evaporation losses—permits loading rain or shine—eliminates danger of sparks. Saves 2 to 8 barrels of gasoline per car loaded.

A complete line, made of high-grade bronze. Accurate threading assures tight connections. Shipped complete with treated leather gasket and forged steel spanner wrench. Sizes, 5 x 2, 5 x 2½, 5 x 3, 5 x 4 in.



Galvanized flexible steel tank car unloading hose available in 2", 2½", 3" and 4" sizes and in any desired length, complete with couplings.

These Are Representative Items from a Comprehensive Line of Oil Handling Equipment. Write for Catalog.

McDONALD